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NATIONAL DAM INSPECTION PROGRAM. OHIO RIVER BASIN, CONNEAUTEE C--ETC(U)
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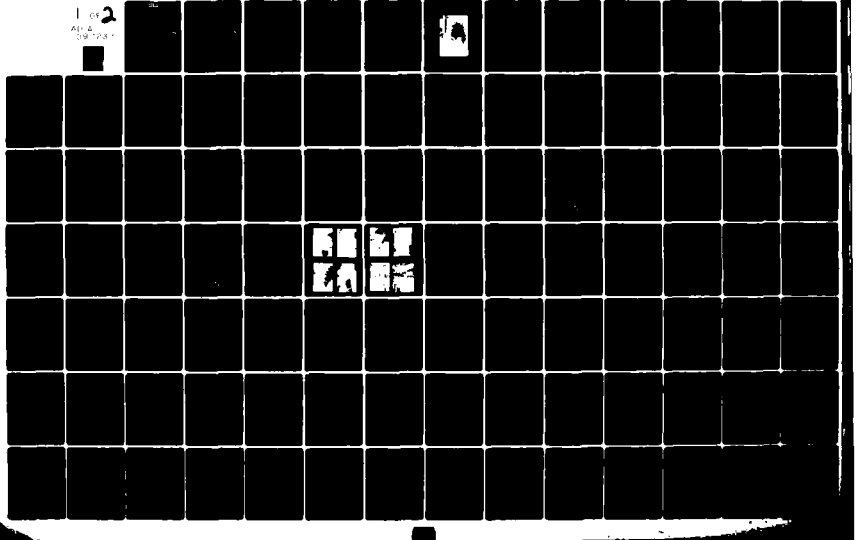

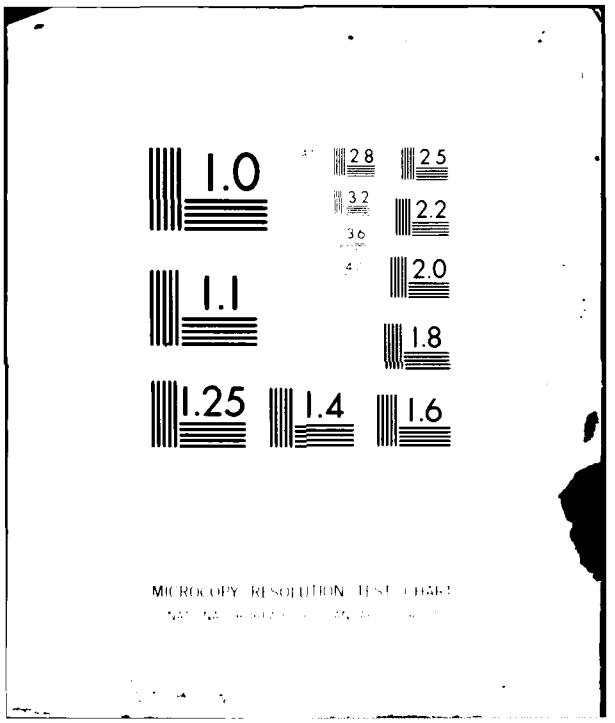
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OHIO RIVER BASIN

CONNEAUTEE CREEK, ERIE COUNTY

PENNSYLVANIA

EDINBORO LAKE DAM

NDI ID NO. PA-18

DER ID NO. 25-4

BOROUGH OF EDINBORO

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

Prepared By

L. ROBERT KIMBALL & ASSOCIATES

CONSULTING ENGINEERS & ARCHITECTS

EBENSBURG, PENNSYLVANIA

15931

FOR

DEPARTMENT OF THE ARMY

BALTIMORE DISTRICT CORPS OF ENGINEERS

BALTIMORE, MARYLAND

21203

MARCH, 1981

(6) National Dam Inspection Program

OHIO RIVER BASIN,
CONNEAUTEE CREEK, ERIE COUNTY,
PENNSYLVANIA

EDINBORO LAKE DAM

NDI ID NO. PA-18,
DER ID NO. 25-4),

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NATIONAL DAM INSPECTION PROGRAM

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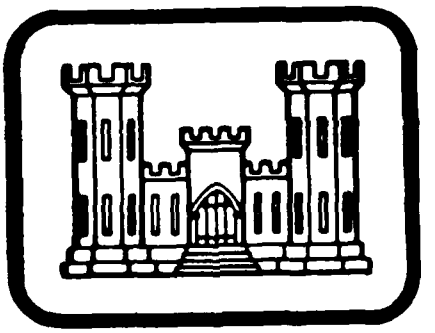

Prepared By
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(15) DACW31-81-C-0012

FOR
DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

MARCH, 1981

411067

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in detemining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Edinboro Lake Dam
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Erie
STREAM	Conneauttee Creek
DATES OF INSPECTION	October 20, 1980 and January 15, 1981
COORDINATES	Lat: 41° 52.6' Long: 80° 08.2'

ASSESSMENT

The assessment of Edinboro Lake Dam is based upon visual observations made at the time of inspection, review of available records and data, hydraulic and hydrologic computations and past operational performance. The inspection and review of data of the Edinboro Lake Dam did not reveal any problems which require emergency action. The dam appears to be in good condition and adequately maintained.

Edinboro Lake Dam is a high hazard-intermediate size dam. The spillway design flood for a dam of this size and classification is the PMF. The spillway and reservoir are capable of controlling approximately 39% of the PMF. Based on criteria established by the Corps of Engineers, the spillway is termed seriously inadequate due to downstream conditions associated with a failure of the gravity spillway section. Edinboro Lake Dam is classified as an unsafe non-emergency dam.

The following recommendations and remedial measures should be instituted immediately.

1. A more detailed stability analysis of the gravity spillway section should be conducted by a Registered Professional Engineer knowledgeable in dam design and construction in conjunction with a detailed hydrologic and hydraulic analysis of the structure to increase spillway capacity and to assess the stability of the structure. Remedial modifications should be completed as indicated by the analysis.

2. A planned maintenance and operation schedule should be prepared and implemented. The plan should include regular inspections by responsible Borough employees to insure that routine maintenance is conducted at the dam.

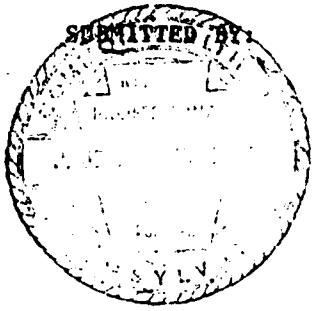
3. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

4. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

5. The facilities to install flashboards in the spillway should be removed.

6. The potential for erosion exists in the area of the grated outlet which provides access to the stop logs in the culvert. Erosion protection should be provided in this area to ensure that erosion does not occur along the toe area and area immediately below the dam.

7. Provision for an upstream shutoff of the concrete conduit should be provided. The culvert should be more thoroughly inspected and modifications made as required.



L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS

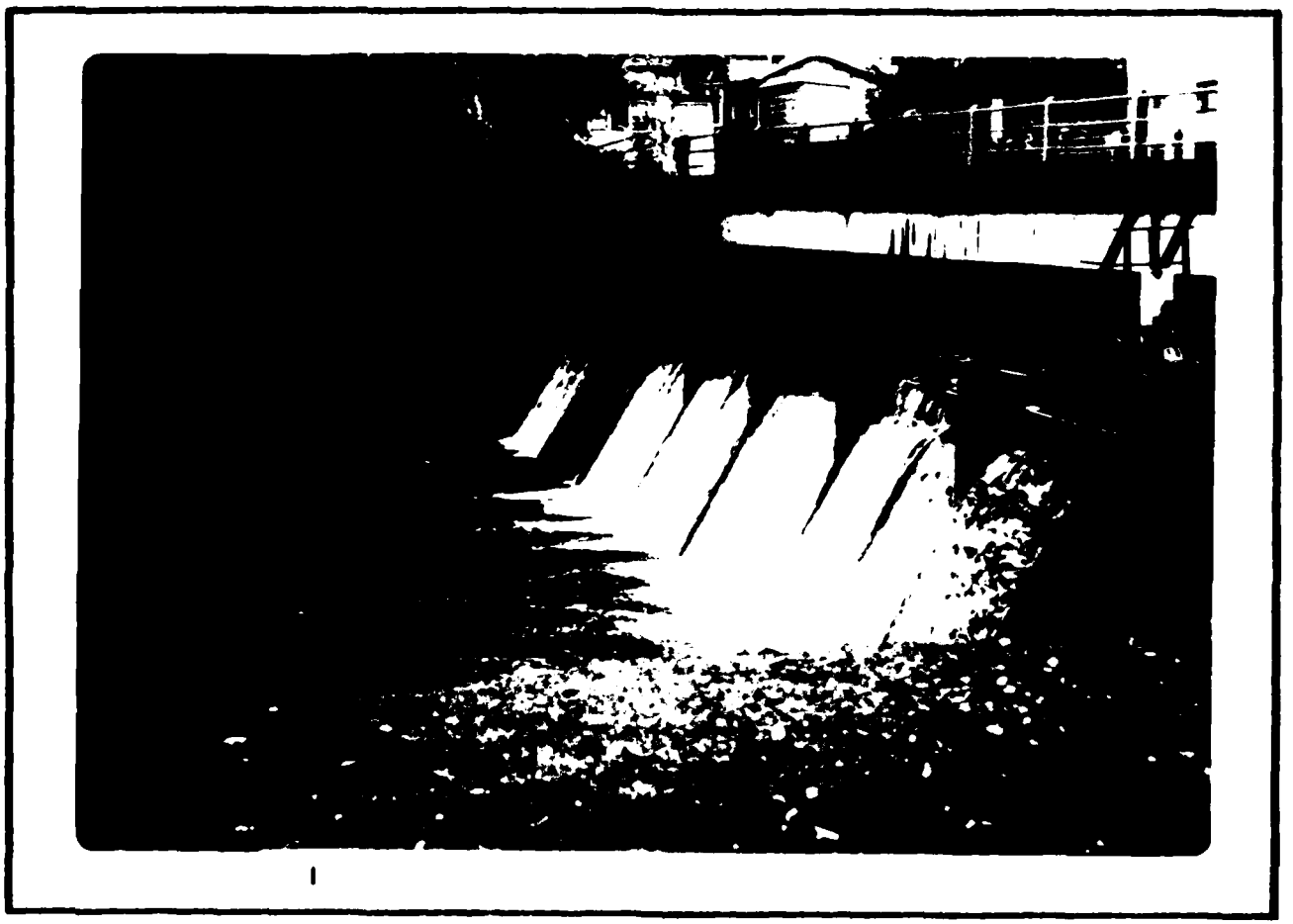
FEB 25, 1981
Date

R. Jeffrey Kimball, P.E.

APPROVED BY:

27 MAR 1981
Date

JAMES W. PECK
COL, Corps of Engineers
District Engineer



Overview of Edinboro Lake Dam

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APPENDICES

PHASE I
NATIONAL DAM INSPECTION PROGRAM

EDINBORO LAKE DAM
NDI. I.D. NO. PA 18
DER I.D. NO. 25-4

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Edinboro Lake Dam is an earthfill dam with a concrete gravity spillway, approximately 200 feet long and 17.5 feet high. A concrete bridge spans the spillway crest. The length and width of the bridge is 94 feet and 26 feet, respectively. The crest of the earthfill portion of the dam is paved for its entire length. A vertical concrete retaining wall exists along the upstream face of the left abutment embankment section. A vertical retaining wall exists on the downstream side of the left embankment section in the area immediately adjacent to the left abutment of the spillway gravity section. The embankment to the right of the spillway has upstream and downstream slopes equal to 2.0H to 2.5H:1V and are grass covered.

An 7.7 foot wide by 9.5 foot high concrete conduit exists through the earthen embankment with the entrance to the conduit located approximately 40 feet left of the left abutment of the spillway gravity section. The outlet of the conduit consists of a 36" corrugated metal pipe located approximately 70 feet from the downstream toe of the left embankment section.

The spillway is a concrete gravity structure having a length between abutments of 83 feet. There are 6 piers, each 12" wide projecting above the crest. Between the 6 piers there exists iron supports which allow the insertion of flashboards. The 14 individual openings are each approximately 5.5 feet long. Flashboards placed on the crest are supported at one end by the concrete piers and at the other end by the iron posts.

b. Location. The dam is located within the Borough of Edinboro, Erie County, Pennsylvania. Edinboro Lake Dam can be located on the Edinboro North, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. Edinboro Lake Dam is an intermediate size dam (17.5 feet high, 6627 acre-feet).

d. Hazard Classification. Edinboro Lake Dam is a high hazard dam. Downstream conditions indicate that a loss of more than a few lives is probable should the structure fail. Several dwellings are located approximately 0.2 miles downstream of the dam.

e. Ownership. Edinboro Lake Dam is owned by the Borough of Edinboro. Correspondence should be addressed to:

The Borough of Edinboro
124 Meadeville Street
Edinboro, PA 16412
Attention: Mr. Randy Sanders, Borough Manager
814/734-1812

f. Purpose of Dam. Edinboro Lake Dam is used for recreation.

g. Design and Construction History. The Edinboro Lake Dam was reconstructed around 1909 by C.W. Billings, a Contractor from Edinboro. The original wooden structure rotted and failed in February, 1907. Based on a 1918 report located in the PennDER files, there was no damage associated with the failure.

A Grist Mill was built into the left abutment. The foundation wall of the mill was located approximately 7.5 feet from the left abutment of the spillway. The existing concrete conduit was originally the mill race and has a width of 9.5 feet and a depth of 7.7 feet. No information exists as to the date of construction of the mill but it was reported by Mr. Dave Crawe, former Edinboro Borough Manager, that the building was removed in the early 60's. The raceway for the mill was not destroyed and continues to exist through the embankment section as a concrete conduit.

h. Normal Operating Procedures. During the winter months the lake is lowered to the entrance invert of the concrete conduit by removing stoplogs located at its downstream end.

1.3 Pertinent Data.

a. Drainage Area. 16.9 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site (Hurricane Agnes) June, 1972	300
Concrete conduit capacity at normal pool	Unknown
Spillway capacity at top of dam	3255

c. Elevation (U.S.G.S. Datum) (feet). - Field survey based on spillway crest elevation 1197 feet obtained from U.S.G.S. 7.5 minute quadrangle.

Top of dam - low point	1204.5
Maximum pool - design surcharge	Unknown
Normal pool	1197.0
Spillway crest	1197.0
Upstream portal - concrete conduit (approximate)	1189
Downstream portal - concrete conduit, 36" CMP	1186
Normal tailwater	1188.1
Toe of dam (downstream toe of gravity section)	1187

d. Reservoir (feet).

Length of maximum pool (PMF)	1400
Length of normal pool	800

e. Storage (acre-feet).

Normal pool	2475
Top of dam	6627

f. Reservoir Surface (acres).

Top of dam	600
Normal pool	250
Spillway crest	250

g. Dam.

Type	Earthfill with concrete gravity spillway
Length	200 feet
Height	17.5 feet
Top width (Minimum)	26 feet
Side slopes (left embankment section)- upstream	Vertical
- downstream	Vertical
Side slopes (right embankment section) - upstream	2.0H to 2.5H:1V
- downstream	2.0H to 2.5H:1V
Zoning	None
Impervious core	None
Cutoff	None
Grout curtain	None

h. Reservoir Drain.

Type	Concrete conduit/ 36" CMP
Length (estimate)	110 feet
Closure	Removable stoplogs
Access	At toe of downstream retaining wall on left embankment section
Regulating facilities	Removable stoplogs

i. Spillway.

Type	Concrete gravity section
Length	83 feet
Crest elevation	1197
Upstream channel	Lake (unrestricted)
Downstream channel	Natural streambed

SECTION 2
ENGINEERING DATA

2.1 Design. Review of available information in the files of the Commonwealth of Pennsylvania, Department of Environmental Resources revealed that some correspondence, permit information and limited detailed drawings of the gravity section and concrete conduit were available for review. No detailed information on the design and original construction of the dam were available for review. All information available was reviewed for this study. The Borough did not provide any additional information.

2.2 Construction. Edinboro Lake Dam was constructed around 1909. No other information is available on construction of the dam.

2.3 Operation. During the winter months the lake is lowered to the entrance invert of the concrete conduit.

2.4 Evaluation.

a. Availability. No engineering data was available for review for the purposes of this report. The owner of the dam is the Borough of Edinboro. A representative of the Borough, Mr. David Crawe, former Borough Manager, was interviewed in regards to the operation and maintenance of the dam.

b. Adequacy. The Phase I Report is based on the visual inspection and hydrologic and hydraulic analysis. Sufficient information exists to complete a Phase I Report.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Edinboro Lake Dam was conducted by personnel of L. Robert Kimball and Associates on October 20, 1980 and January 15, 1981. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appears to be in good condition. From a brief survey conducted during the inspection, it was noted that the low spot on the top of dam exists near the left abutment on the left embankment section. The crest of the dam is paved for its entire length. A roadway exists across the crest of the dam. A roadway bridge spans the spillway crest. Two vertical retaining walls exist on the upstream and downstream face of the left embankment section. The right embankment section has upstream and downstream slopes equal to 2H:1V to 2.5H:1V. Both the upstream and downstream slopes of the right embankment section are grass covered. No seepage was observed on the downstream face, slopes or beyond the toe of the embankment sections.

c. Appurtenant Structures. A concrete gravity spillway exists about mid-way across the embankment section. The spillway crest is 83 feet long between the abutments and a concrete bridge spans the spillway crest. Six concrete piers exist along the spillway crest with iron posts equally spaced between the 6 piers. The posts and piers are utilized as supports for wooden flashboards.

A concrete culvert exists through the left embankment section with the entrance to the culvert on the upstream face of the left embankment section. The concrete culvert has a width of 9.5 feet and a depth of 7.7 feet. The downstream end of the culvert is controlled by wooden stoplogs. An iron grate which provides an entrance to the stoplogs exists at the toe of a concrete retaining wall on the downstream face of the left embankment section. The potential exists for flows to discharge from the downstream end of the culvert thus producing a potential for erosion at the toe of the dam. A 36" corrugated metal pipe discharges flows from the concrete culvert into the stream below the dam. The concrete culvert can be utilized to drain the reservoir.

d. Reservoir Area. The reservoir slopes are gentle to moderate and do not appear to be susceptible to massive landslides which would affect the storage volume of the reservoir or cause overtopping of the dam by displacing water.

e. Downstream Channel. The downstream channel of the Edinboro Lake Dam is relatively wide for a distance of approximately 5 miles at which point flows in the Conneauttee Creek discharge into the Drakes Mills Dam. The Drakes Mills Dam is located approximately 4 1/2 miles below Edinboro Lake Dam.

3.2 Evaluation. The embankment sections of the Edinboro Lake Dam appeared to be in good condition. The crest of the embankment section consists of a paved roadway. The left embankment section is confined between vertical retaining walls which exist on the upstream and downstream face of the embankment section. No seepage was observed during the inspection.

The concrete gravity section appeared to be in fair condition. No visible deficiencies were observed during the inspections. Flows over the spillway section during the October 20, 1980 inspection and heavy snow which covered the spillway section during the January 15, 1981 inspection hampered attempts to observe the downstream face and crest of the spillway section. The roadway bridge which spans the spillway crest is a relatively new structure and appeared to be in good condition.

Inspection of the concrete culvert through the left embankment section was impossible during the October 20, 1980 inspection. During the January 15, 1981 inspection, the waterlevel in the reservoir had been drawn down and a better view to the entrance to the culvert was possible. The visible portion of the entrance to the culvert was unrestricted. A crack was observed on the left interior wall of the culvert. The crack did not appear to be excessive. No determination could be made relative to the actual condition of the culvert. Since the reservoir was lowered, a better view of the upstream face of the retaining wall was possible. The concrete appeared to be in fair condition and no large visible cracks were observed.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The waterlevel in the Edinboro Lake Dam is maintained at the spillway crest elevation, 1197.0. It was reported by the former Edinboro, Borough Manager, Mr. David Crawe that the reservoir level is drawn down during the winter months. During the January 15, 1981 inspection it was observed that the lake was lowered. The possibility of placing flashboards in the spillway exists. However the Borough normally does not install the flashboards.

4.2 Maintenance of the Dam. No planned maintenance schedule exists for the Edinboro Lake Dam. Maintenance on the dam is conducted on an unscheduled, as-needed basis.

4.3 Maintenance of Operating Facilities. The concrete culvert which exists through the left embankment section is equipped with stoplogs on the downstream end of the culvert. It was reported by Mr. David Crawe, that the reservoir is lowered during the winter months. It was observed during the January 15, 1981 inspection that the lake was in a drawn down condition. The culvert is capable of reducing the water level in the reservoir.

4.4 Warning System in Effect. There is no warning system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. The condition of the Edinboro Lake Dam is considered good. There was no warning system in effect to warn downstream residents at the time of the inspection. An emergency action plan should be available for every dam in the high and significant hazard category. Such plans should outline actions to be taken by the operator to minimize downstream effects of an emergency and should include an effective warning system. An emergency action plan has not been developed, the owner should develop such an action plan.

Since the dam was in a near drained condition as observed during the January 15, 1981 inspection, it is evident that the stop logs in the concrete culvert were removed. A close visual inspection of the stop log retaining structure at the downstream end of the concrete culvert was not possible during the January 15, 1981 inspection due to heavy snow.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. The DER files did not contain any hydrologic or hydraulic design calculations used in the design of these facilities. No calculations or design data pertaining to hydrology or hydraulics were available.

b. Experience Data. No rainfall, runoff or reservoir level data were available. The information contained in the DER correspondence file indicated that an old dam existed at the site which rotted and failed about February, 1907. No damages were associated with the failure of the dam. The present dam was built in 1909 by an Edinboro contractor.

c. Visual Observations. The spillway appeared to be in fair condition. The concrete piers and iron posts which are located along the spillway crest appeared to be in fair condition. Only one flashboard near the right edge of the spillway was in place. No other flashboards existed along the spillway crest.

Discharges through the concrete culvert, which exists through the left embankment section, is controlled by stop logs on the downstream end of the culvert. Flows through the culvert discharge through a 36" corrugated metal pipe. Flow through the culvert would be controlled by the discharge potential of the corrugated metal pipe. The discharge potential was considered to be minimal and therefore, was not considered in the overtopping analysis.

The low point on the top of dam exists near the left abutment. The low spot elevation is not easily identifiable by the naked eye. The low point on the top of dam was selected based on a brief survey conducted during the October 20, 1980 inspection.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D.

5.2 Evaluation Assumptions. To enable the completion of the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. Pool elevation prior to the storm was at the spillway crest elevation, 1197.0.

2. The top of dam was considered the low spot elevation, 1204.5.

3. The flashboard retaining structure which exists on the spillway crest contains 6 concrete piers approximately 1 foot wide. These 6 concrete piers reduce the weir length by 6 feet. This condition was not considered in the analysis since the concrete culvert would discharge a flow which was considered equal to that flow retarded by the 6 concrete piers. No discharge potential was considered for the concrete culvert.

4. The entire spillway crest was assumed to be at elevation 1197.0.

5.3 Summary of Overtopping Analysis. Complete summary sheets for the computer output are presented in Appendix D.

Peak inflow (PMF)	24470 cfs
Spillway capacity	3255 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) for a dam of this size and classification is the PMF. Based on the following definition provided by the Corps of Engineers, the spillway is rated as seriously inadequate as a result of our hydrologic analysis. Edinboro Lake Dam is classified as an unsafe non-emergency dam.

> Seriously inadequate - High hazard classification dams which do not not pass 50% of the spillway design flood and where there is a significant increase in the hazard potential for loss of life due to a dam failure.

The spillway and reservoir are capable of controlling approximately 39% of the PMF without overtopping the embankment.

5.4 Summary of Dam Breach Analysis. As the subject dam cannot satisfactorily pass 50% of the PMF (based on our analysis) it was necessary to perform a dam breach analysis and downstream routing of the flood wave. This analysis determines the degree of increase flooding due to dam failure.

Two potential failure conditions were considered during the dam breach analysis. The first breach analysis considered a failure of the embankment at the right abutment due to overtopping. An elevation of 1206 which represents an overtopping in the area equal to 0.20 feet for a duration of less than 2 hours. The second breach analysis considered a failure of the gravity spillway section. An elevation of 1206 was considered as sufficient to cause a failure of the gravity

section. Stability analysis calculations which appear in Appendix G indicate that the potential for failure of the gravity section could occur at an elevation less than 1206. Elevation 1206 was considered since it approximated the maximum reservoir water surface elevation during a 1/2 PMF event. This elevation was also used in calculations of the stability analysis which ultimately indicated that the structure was unstable at this pool elevation.

The flood wave was routed downstream with and without failure considerations. The downstream potential for loss of life and property damage is significantly increased by dam failure as indicated by the analysis. The potential for increased flooding downstream is significant based on the calculated instability of the structure and the potential flood wave associated with such a failure. Therefore, the spillway is rated as seriously inadequate. The dam is classified as an unsafe non-emergency dam.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. No erosion was observed on the embankment crest or slopes at the time of inspection. No seepage was observed during the time of inspection. No structural deficiencies were observed that would affect the stability of the embankment section or the concrete gravity spillway.

The embankment crest consists of a paved roadway surface and the left earthen embankment section widens considerably near the left abutment contact.

Flows through the concrete conduit are restricted by the 36" diameter pipe. In past floods, a significant flow through the grating caused erosion of the bank immediately downstream of the dam.

b. Design and Construction Data. Only limited information regarding the design of the concrete gravity section and original grist mill flume were available in the DER files. No construction data was available for review. The concrete spillway gravity section drawing was utilized in the stability analysis calculations located in Appendix G of this report.

c. Operating Records. No operations are conducted at the dam other than the lowering of the reservoir each winter. No records regarding the reservoir levels are maintained at the Borough Office.

d. Post Construction Changes. No post construction changes are known to have occurred since the structure was rebuilt in 1909. A roadway bridge which spans the spillway crest was rebuilt during the early 1960's.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analyses has been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading. Based on the results of the stability analysis contained in Appendix G, a sufficient factor of safety, under static loading conditions may be less than a minimum accepted value. A more detailed stability analysis should be conducted and the analysis should include a determination of seismic stability.

f. Stability Analysis. An approximation of the stability of the gravity spillway section was performed for this study. A check of the stability was performed using the reservoir pool elevation associated with a 1/2 PMF event. A water surface elevation in the reservoir of 1206.0 was considered for our analysis. The assumptions used for the analysis and the calculations appear in Appendix G of this report.

Based on the assumed conditions, the analyses revealed that the dam is unstable at the pool elevation considered. Factors of safety equal to 1.01 (sliding) and 1.08 (overtopping) resulted from the analysis. The results of the stability analysis indicate that the potential for failure exists at an elevation less than 1206.0. More detailed and accurate analyses are required.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam appears to be in good condition and adequately maintained. No erosion or seepage were observed during the inspection. No obvious signs of instability were observed on the concrete gravity section. A major portion of the spillway section was unobservable due to flows over the spillway crest. The visual observations, review of available data, hydrologic and hydraulic calculations and past operation performance indicate that the Edinboro Lake Dam is capable of controlling approximately 39% of the PMF without overtopping the embankment. The spillway is classified as seriously inadequate, unsafe non-emergency.

The stability of the gravity spillway is questionable and a more detailed analysis of the structure should be completed.

b. Adeqacy of Information. Sufficient information is available to complete a Phase I Report.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigation. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required.

7.2 Recommendations/Remedial Measures.

1. A more detailed stability analysis of the gravity spillway section should be conducted by a Registered Professional Engineer knowledgeable in dam design and construction in conjunctin with a detailed hydrologic and hydraulic analysis of the structure to increase spillway capacity and to assess the stability of the structure. Remedial modifications should be completed as indicated by the analysis.

2. A planned maintenance and operation schedule should be prepared and implemented. The plan should include regular inspections by responsible Borough employees to insure that routine maintenance is conducted at the dam.

3. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.

4. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

5. The facilities to install flashboards in the spillway should be removed.

6. The potential for erosion exists in the area of the grated outlet which provides access to the stop logs in the culvert. Erosion protection should be provided in this area to ensure that erosion does not occur along the toe area and area immediately below the dam.

7. Provision for an upstream shutoff of the concrete conduit should be provided. The culvert should be more thoroughly inspected and modifications made as required.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Edinboro Lake Dam COUNTY Erie STATE Pennsylvania ID# PA 18

TYPE OF DAM Earthfill with concrete gravity spillway HAZARD CATEGORY High

DATE(s) INSPECTION October 20, 1980 January 15, 1981 WEATHER Cold and rainy Cold with snow flurrys TEMPERATURE 40° 22°

POOL ELEVATION AT TIME OF INSPECTION 1197 10/20/80 less than 1197 1/15/81 M.S.L. TAILWATER AT TIME OF INSPECTION 1188.1 10/20/80 None 1/15/81 M.S.L.

A-1

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates

James T. Hockensmith - L. Robert Kimball and Associates

O.T. McConnell - L. Robert Kimball and Associates

O.T. McConnell RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Appears good.	
RIPRAP FAILURES	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Crest is paved and slopes are grass covered.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appears to be good.	
ANY NOTICEABLE SEEPAGE	None.	
STAFF GAUGE AND RECORDER	None.	
DRAINS	None.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	None.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Appears to be all right.	
DRAINS	None.	
WATER PASSAGES	Appears to be all right.	
FOUNDATION	Unknown.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Close inspection of the gravity section was prevented due to discharge over crest.	
STRUCTURAL CRACKING	None observed.	
VERTICAL AND HORIZONTAL ALIGNMENT	All right.	
MONOLITH JOINTS	Appear all right.	
CONSTRUCTION JOINTS	Not observed.	
STAFF GAUGE OR RECORDER	None.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	One crack on left interior wall of concrete conduit. No cracking or excessive spalling of concrete surfaces observed.	A more thorough inspection of the culvert should be made to assess the actual condition.
INTAKE STRUCTURE	Unrestricted.	
OUTLET STRUCTURE	36" corrugated metal pipe.	
OUTLET CHANNEL	Natural stream.	
EMERGENCY GATE	Stoplogs.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Modified sharp crest. The weir appeared to be in good condition and well maintained. Retaining structures along the crest allow the placement of flashboards.	
APPROACH CHANNEL	Unrestricted.	
DISCHARGE CHANNEL	Natural stream.	
BRIDGE AND PIERS	Roadway bridge spans spillway crest, no bridge piers.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	*Not applicable.*	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

DOWNSTREAM CHANNEL

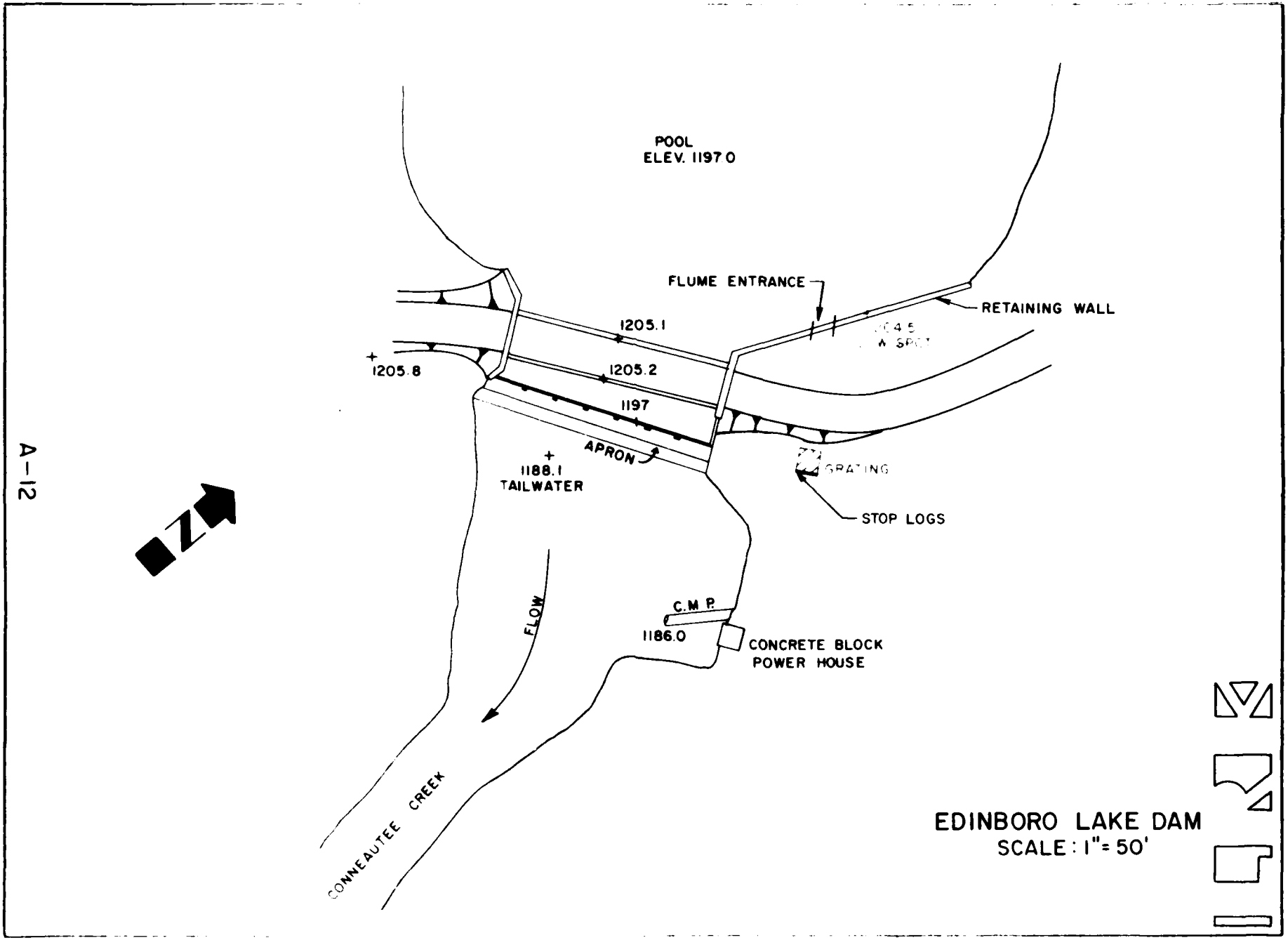
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Relatively wide channel for a dischance of approximately 5 miles at which point discharges enter the Drakes Mills Dam.	
SLOPES	Appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	Approximately two homes - 8 people within 0.2 miles of the dam.	

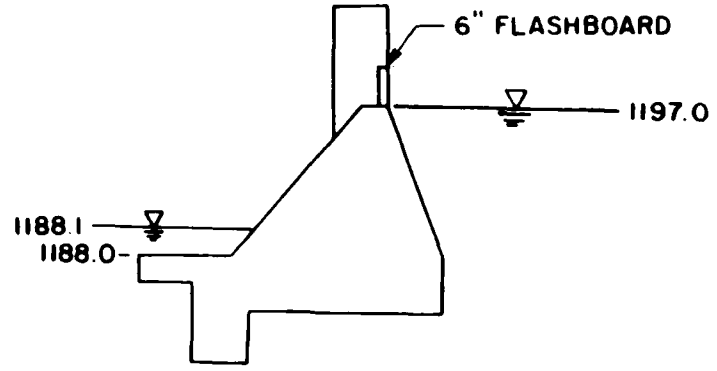
RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gentle to moderate slopes. Appear to be stable.	
SEDIMENTATION	Unknown.	

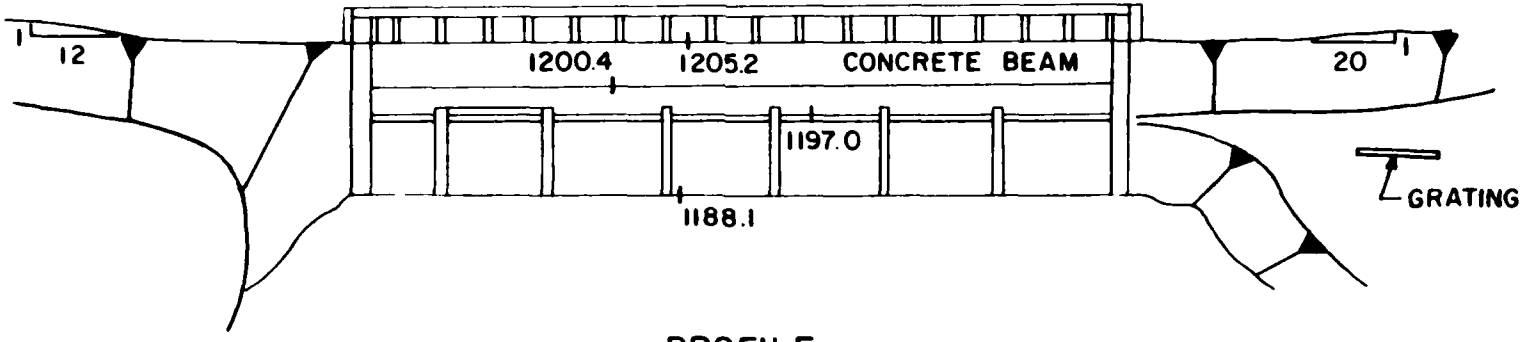
INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	


POOL
ELEV. 1197.0
FLUME ENTRANCE
RETAINING WALL
1205.1
1205.2
1205.8
1197
APRON
1188.1
TAILWATER
GRATING
STOP LOGS
FLOW
C.M.P.
1186.0
CONCRETE BLOCK
POWER HOUSE
CONNEAUTEE CREEK
EDINBORO LAKE DAM
SCALE: 1"= 50'



SPILLWAY SECTION
(NOT TO SCALE)



PROFILE
LOOKING UPSTREAM
(SCALE: 1"=20')

EDINBORO LAKE DAM

APPENDIX B
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Edinboro Lake Dam

ID# PA 18

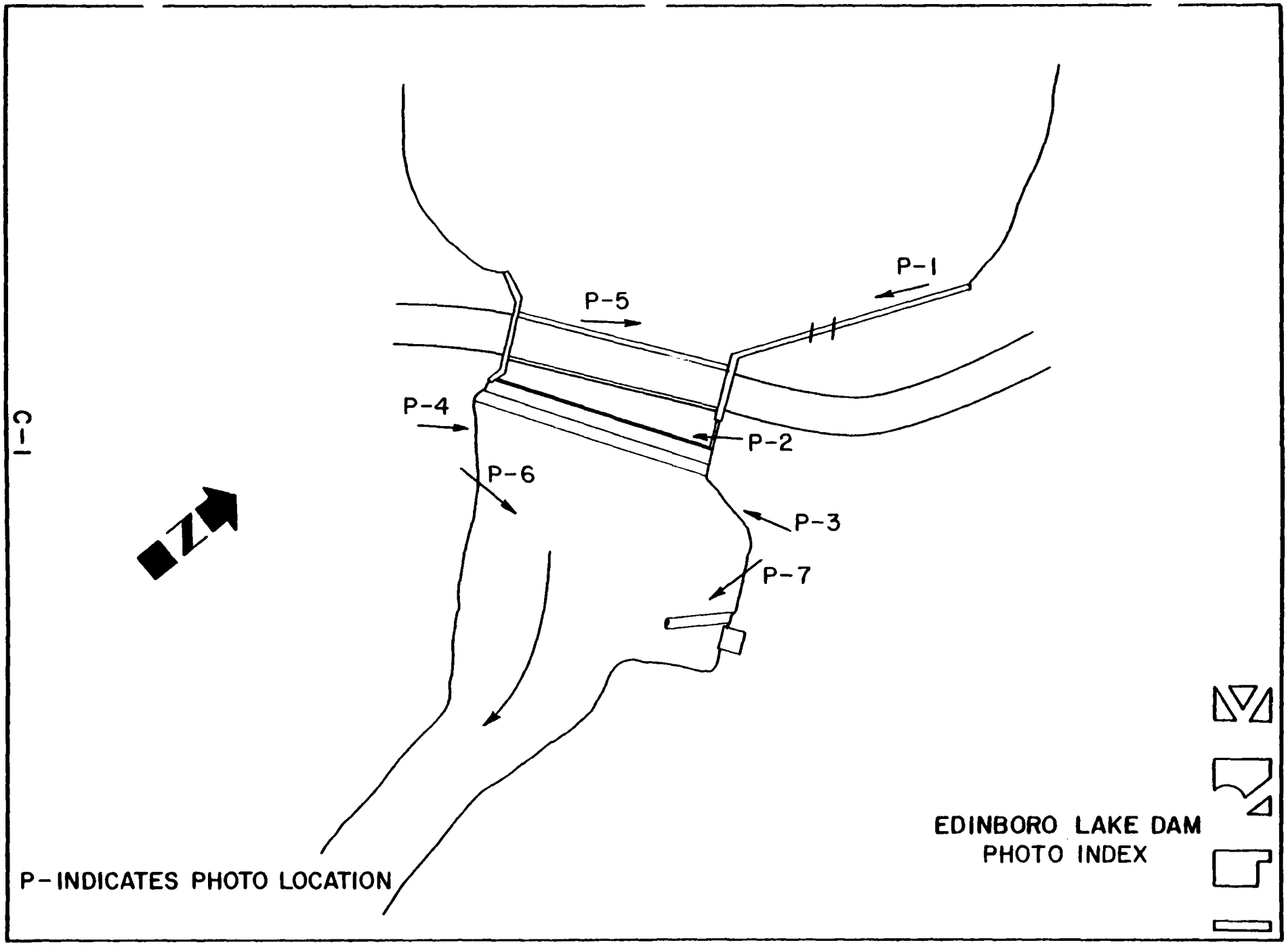
ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. quadrangle.
CONSTRUCTION HISTORY	None.
TYPICAL SECTIONS OF DAM	See Appendix G.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	Available in DER files. Available in DER files. None. None. None.

ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None.
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None since reconstruction in 1909.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	DER inspection reports available in DER files.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	DER file contains an inspection report which mentions a failure of an original wooden structure which rottened and failed about February, 1907. The present dam was built in 1909 by C.W. Billings, a Contractor of Edinboro. The inspection report remarks that no damage was associated with the original failure.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	None.
OPERATING EQUIPMENT PLANS & DETAILS	None.

APPENDIX C
PHOTOGRAPHS


P-1
P-5
P-4
P-2
P-6
P-3
P-7
N
P-INDICATES PHOTO LOCATION
EDINBORO LAKE DAM
PHOTO INDEX

EDINBORO LAKE DAM
PA 18

Sheet 1

Front

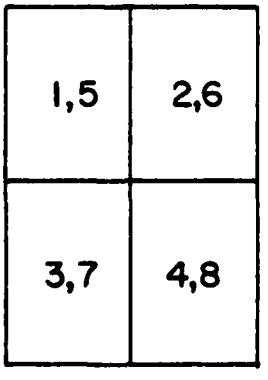
(1) Spillway approach. View towards right abutment (note: bridge).
(2) Spillway crest (note: flashboard retaining structure). View towards right abutment.
(3) View of spillway gravity section.
(4) Spillway (view towards left abutment).

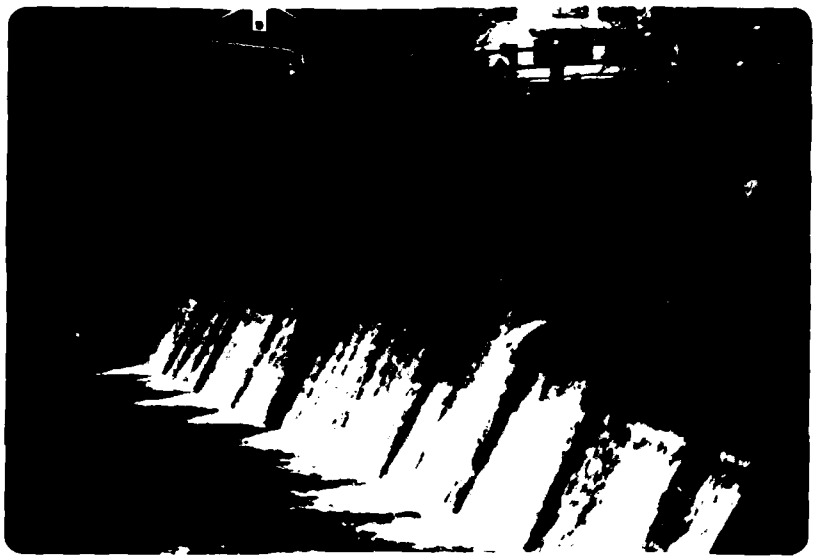
Sheet 1

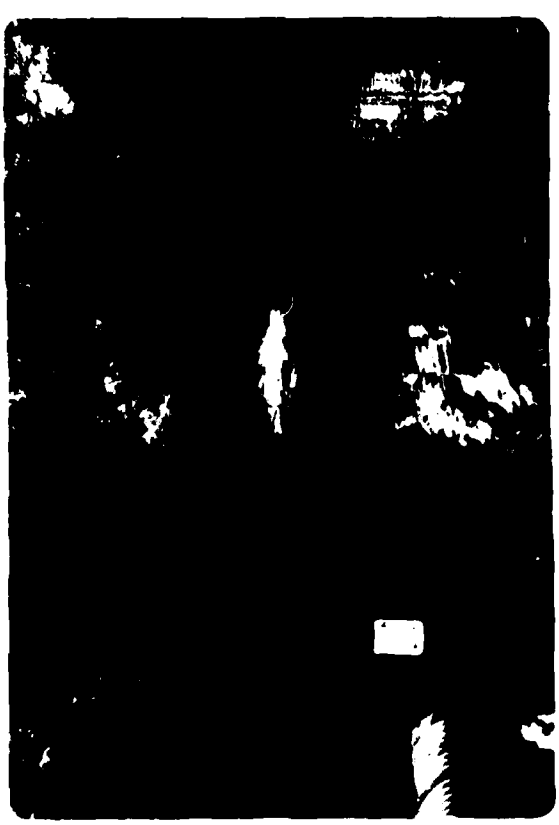
Back

(5) View of the upstream face at left abutment (note the partial view of the intake for the concrete conduit).
(6) View of the 36" diameter CMP and pumphouse.
(7) Downstream channel.
(8) Downstream exposure.

TOP OF PAGE







APPENDIX D
HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Investigation), September, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 40" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topgraphic
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

HYDROLOGY AND HYDRAULICS ANALYSIS
DATA BASE

NAME OF DAM: Edinboro Lake Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) [illegible] inches

STATION	1		3	4	5	6
Station Description	A	B	C			
Drainage Area (square miles)	2.39	[illegible]	[illegible]	[illegible]	1.17	2.17
Cumulative Drainage Area (square miles)	[illegible]	[illegible]	8.[illegible]	13.5	14.7[illegible]	16.91
Adjustment of PMF for Drainage Area (%)(1)						
6 hours			1[illegible]2			
12 hours			[illegible]			
24 hours			[illegible]			
48 hours			1[illegible]			
72 hours			[illegible]			
Snyder Hydrograph Parameters						
Zone (2)			[illegible]			
Cp (3)			[illegible]			
Ct (3)			[illegible]			
L (miles) (4)	2.77	2.84	4.91	[illegible]	2.61	[illegible]
Lca (miles) (4)	1.36	1.52	2.[illegible]	2.[illegible]	1.40	1.[illegible]
tp = Ct(LxLca) 0.3 hrs.	4.91	5.12	7.[illegible]	6.[illegible]	[illegible].87	5.[illegible]
Spillway Data						
Crest Length (ft)			[illegible]			
Freeboard (ft)			[illegible].5			
Discharge Coefficient			[illegible].[illegible]			
Exponent			[illegible].5			

(1) Hydrometeorological Report 33 ([illegible]), U.S. [illegible] U.S. Army Corps of Engineers, 1956.

(2) Hydrological zone defined by Corps of Engineers, [illegible] District, for determining Snyder's coefficients (Cp and Ct).

(3) Snyder's Coefficients.

(4) L=Length of longest water course from outlet to basin [illegible]. Lca=Length of water course from outlet to [illegible] centroid of drainage area.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 16.91 sq.mi gentle to moderate slopes

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1197 - [2475 ac-ft]

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1204.5 - [6627 ac-

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1204.5 - Low spot

SPILLWAY CREST:

a. Elevation 1197
b. Type Modified sharp crest
c. Width Unknown
d. Length 83 feet between spillway abutment
e. Location Spillover Mid embankment
f. Number and Type of Gates None

OUTLET WORKS:

a. Type Concrete conduit - width = 9.5 feet & a depth of 7.66'
b. Location Through left embankment section
c. Entrance inverts Unknown
d. Exit inverts 1188.1
e. Emergency drawdown facilities Concrete conduit with stoplogs

HYDROMETEOROLOGICAL GAUGES:

a. Type None
b. Location None
c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

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NAME EDINBORO LAKE DAM
NUMBER PA-18
SHEET NO. 1 OF 3
BY CTM DATE 12/80

LOSS RATE AND BASE FLOW PARAMETERS

AS RECOMMENDED BY THE BALTIMORE DISTRICT CORPS OF ENGINEERS.

STRTL = 1 INCH
CNSTL = 0.05 IN/HR.
STRTQ = 1.5 cfs/MI^2
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2

ELEVATION-AREA-CAPACITY RELATIONSHIP

FROM D.E.R. FILE AND U.S.G.S. 7.5-MIN. QUAD.

SPILLWAY CREST ELEV. = 1197'
INITIAL STORAGE = 802 X 10^6 GALLONS OR 2,461 AC-FT
AREA AT ELEV. 1197 = 0.39 MI^2 OR 250 AC.

FROM THE CONIC METHOD FOR RESERVOIR VOLUME, FLOOD HYDROGRAPH PACKAGE (HEC-1) DAM SAFETY VERSION (USER'S MANUAL).

$H = 3V/A$
$= 3(2,461)/250$
$= 29.5$ FT.

ELEVATION WHERE AREA EQUALS ZERO;

$1197' - 29.7' = 1167.5'$

AT ELEV. 1200, AREA = 588 AC.
AT ELEV. 1210, AREA = 891 AC.

ELEVATION (FT)	1167.3	1197	1200	1210
AREA (AC)	0	250	588	891

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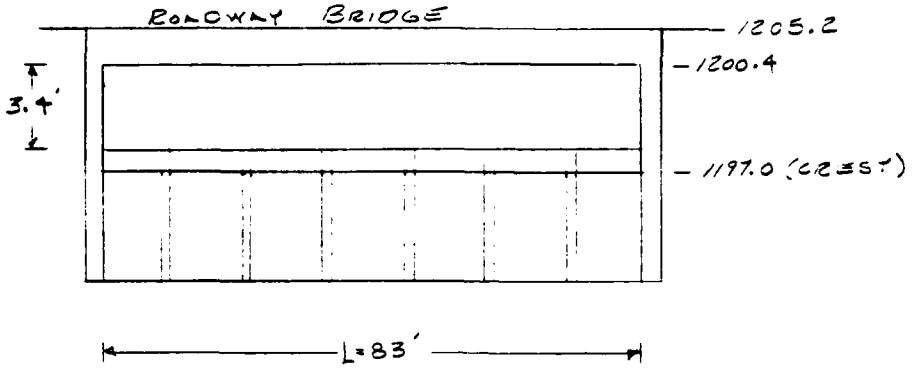
EBENSBURG PENNSYLVANIA

NAME
NUMBER PA-18
SHEET NO. 2 OF 5
BY OTM DATE 12/80

DISCHARGE RATING



NOTE: THE EFFECTIVE LENGTH IS LESS THAN 83' BELOW ELEVATION 1198 (APPROX.). FOR THE PURPOSE OF THIS ANALYSIS THE TOTAL WEIR LENGTH WILL BE CONSIDERED AS 83'.

USE 3.3 FOR THE COEFFICIENT OF DISCHARGE FOR A SHARP CRESTED WEIR.

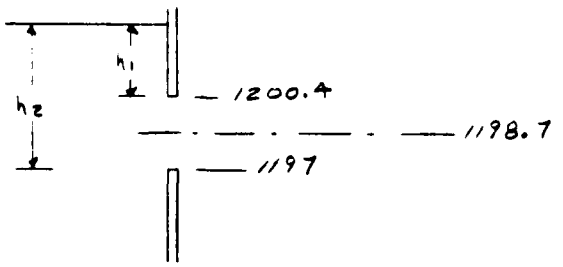
POOL ELEVATIONS BELOW 1201 FEET WILL BE CONSIDERED AS CREATING A STANDARD WEIR DISCHARGE.

USE $Q = CLH^{3/2}$

POOL ELEVATIONS ABOVE 1201 FEET WILL BE CONSIDERED AS CREATING ORIFICE FLOW.

USE $Q = \frac{2}{3} C \sqrt{2g} L (h_2^{3/2} - h_1^{3/2})$

WHERE $C = 0.6$ $L = 83'$ $g = 32.2$



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NAME
NUMBER PA - 18
SHEET NO. 3 OF 5
BY DTM DATE 12/80

DISCHARGE THRU THE FLUME AT THE LEFT ABUTMENT WAS NOT CONSIDERED.

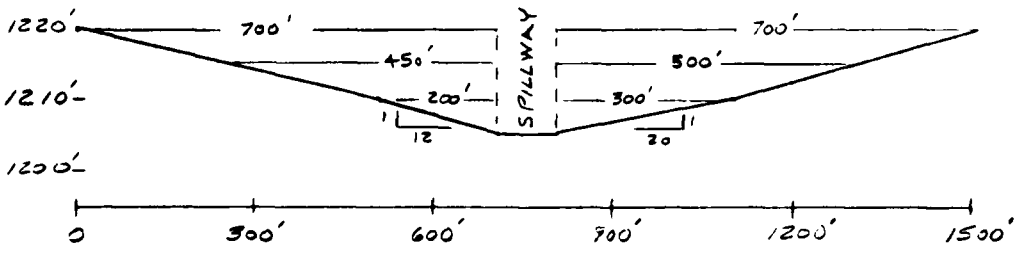
ELEV. (FT.)	WEIR		ORIFICE			DISCHARGE *(Q) (CFS.)
	h (FT.)	Q (CFS)	h_2 (FT.)	h_1 (FT.)	Q (CFS)	
1197	0	0				0
1198	1	274				270
1199	2	775				780
1200	3	1423				1420
1201	4	2191				2190
1202			5	1.6	2440	2440
1204			7	3.6	3115	3120
1206			9	5.6	3663	3660
1208			11	7.6	4138	4140
1210			13	9.6	4563	4560

* VALUES ROUNDED TO NEAREST 10 C.F.S.

OVERTOPPING PARAMETERS

TOP OF DAM (LOW SPOT) = 1204.5'
LENGTH OF DAM (EXCLUDING SPILLWAY) = 110'

FROM U.S.G.S. 7.5-MIN QUAD. AND FEC INSPECTION NOTES AND OBSERVATIONS.



#L	30	500	950	1400
#Y	1205	1210	1215	1220

USE C = 2.9 (BROAD CREST)

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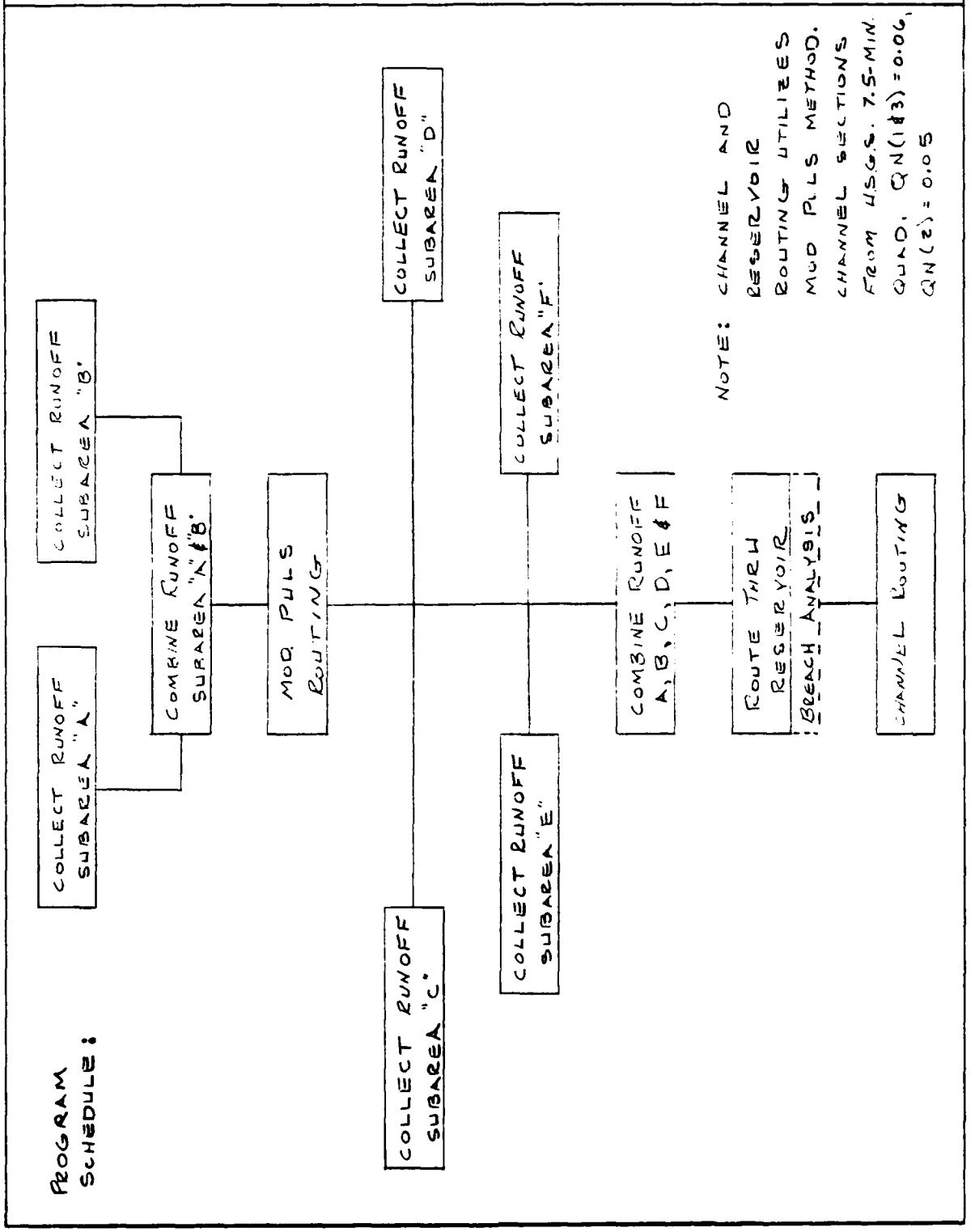
NAME
NUMBER PA-18
SHEET NO. 4 OF 5
BY OTM DATE 12/80



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EBENSBURG PENNSYLVANIA

NAME
NUMBER PA-18
SHEET NO. 5 OF 5
BY DTM DATE 11/81

BREACH ANALYSIS

PLAN 1: CONSIDER FAILURE OF THE RIGHT EARTHEN EMBANKMENT SECTION DUE TO 0.20 FEET OVERTOPPING DURING A ½ PMP EVENT.

1. BRMID = 10'
2. Z = 0.5
3. ELBM = TAILWATER ELEV. (1188)
4. TFAIL = 2 HRS.
5. WSEL = 1197
6. FAILEL = 1206

PLAN 2: CONSIDER A FAILURE OF THE CONCRETE SPILLWAY GRAVITY SECTION.

1. BRMID = SECTION LENGTH = 83'
2. Z = 0
3. ELBM = 1188.1
4. TFAIL = 10 MIN OR 0.17 HRS
5. WSEL = 1197
6. FAILEL = 1206

PLAN 3: NO FAILURE CONSIDERED.

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION   01 APR 80
**********
    1          A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
    2          A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF EDINBORO LAKE DAM
    3          A3       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR (PA-00018)
    4          B    288       0      10       0       0       0       0       0      -4       0
    5          B1     5
    6          J      1       5       1
    7          J1   .39      .4      .5      .6       1
    8          K      0       1                                               1
    9          K1       INFLOW SUBAREA A
   10          M      1       1    2.49                                       1
   11          P               23.     112     122     136     146
   12          T                                                       1.0    0.05
   13          W   4.91    0.55
   14          X   -1.5    -.05     2.0
   15          K      0       2
   16          K1       INFLOW SUBAREA B
   17          M      1       1    1.32                                       1
   18          P               23.     112     122     136     146
   19          T                                                       1.0    0.05
   20          W   5.12    0.55
   21          X   -1.5    -.05     2.0
   22          K      2       3                                               1
   23          K1       COMBINE INFLOW (SUBAREA A AND B)
   24          K      1       4                                               1
   25          K1       MOD PULS ROUTING
   26          V                                       I       I
   27          Y1     1
   28          Y6   .06      .05     .06    1198    1220    5280   .0038
   29          Y7     0    1220     260    1210     896    1200     898    1198     902    1198
   30          Y7   904    1200    1300    1210    1850    1220
   31          K      0       5                                               1
   32          K1       INFLOW SUBAREA C
   33          M      1       1    4.56                                       1
   34          P               23.     112     122     136     146
   35          T                                                       1.0    0.05
   36          W   7.08    0.55
   37          X   -1.5    -.05     2.0
   38          K      0       6                                               1
   39          K1       INFLOW SUBAREA D
   40          M      1       1    5.22                                       1
   41          P               23.     112     122     136     146
   42          T                                                       1.0    0.05
   43          W   6.53    0.55
   44          X   -1.5    -.05     2.0
   45          K      0       7                                               1
```

```
46          K1      INFLOW SUBAREA E
47          M    1      1    1.17                              1
48          P                23.     112     122     136     146
49          T                                                        1.0     0.05
50          W   4.87    0.55
51          X   -1.5    -.05     2.0
52          K     0       8                                          1
53          K1      INFLOW SUBAREA F
54          M    1      1    2.17                              1
55          P                23.     112     122     136     146
56          T                                                        1.0     0.05
57          W   5.28    0.55
58          X   -1.5    -.05     2.0
59          K     5       9                                          1
60          K1      COMBINE INFLOW (SUBAREAS A,B,C,D,E AND F)
61          K     1      10                                          1
62          K1      ROUTE THRU EDINBORO LAKE
63          Y                                    1       1
64          Y1    1                                                 -1197    -1
65          Y4  1197    1198    1199    1200    1201    1202    1204    1206    1208    1210
66          Y5    0     270     780    1420    2190    2440    3120    3660    4140    4560
67          $A    0     250     588     891
68          $E1167.3    1197    1200    1210
69          $$  1197
70          $D1204.5     2.9     1.5     110
71          $L    30     500     950    1400
72          $V  1205    1210    1215    1220
73          K     99
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********

RUN  DATE= 81/01/22.
     TIME= 08.08.57.
```

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF EDINBORO LAKE DAM
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR (PA-00019)

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS= .39 .40 .50 .60 1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

INFLOW SUBAREA A

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.49	0.00	2.49	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.00	112.00	122.00	136.00	146.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 4.91 CP= .55 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH END-OF-PERIOD ORDINATES, LAG= 4.89 HOURS, CP= .55 VOL= .91

4.	4.	9.	15.	21.	28.	36.	44.	52.	61.
70.	79.	87.	98.	108.	118.	128.	137.	145.	153.
160.	166.	171.	176.	180.	183.	185.	187.	187.	186.
184.	179.	174.	169.	164.	160.	155.	151.	146.	142.

138.	134.	130.	127.	[illegible]	[illegible]	116.	113.	110.	106.
103.	100.	98.	95.	92.	[illegible]	[illegible]	83.	82.	80.
77.	75.	73.	71.	69.	67.	[illegible]	[illegible]	66.	45.
58.	56.	55.	53.	52.	50.	[illegible]	[illegible]	[illegible]	43.
43.	42.	41.	40.	39.	37.	[illegible]	[illegible]	[illegible]	[illegible]
32.	32.	31.	30.	29.	28.	[illegible]	[illegible]	[illegible]	[illegible]

0

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
		SUM	33.58	31.09	2.49	196267.
			853.11	790.11	63.11	5557.661

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SUB-AREA RUNOFF COMPUTATION

INFLOW SUBAREA B

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	0	0	0	0	0	0	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.32	0.00	1.32	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.00	112.00	122.00	136.00	146.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 5.12 CP= .55 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES. LAG= 5.13 HOURS, CP= .55 VOL= .90

1.	2.	4.	7.	10.	13.	17.	21.	25.	29.
33.	38.	42.	47.	52.	57.	62.	66.	71.	74.
78.	81.	84.	87.	89.	91.	93.	94.	95.	95.
95.	94.	92.	89.	87.	85.	82.	80.	78.	76.
74.	72.	70.	68.	66.	64.	62.	61.	59.	57.
56.	54.	53.	51.	50.	49.	47.	46.	45.	43.

42.	41.	40.	39.	38.	37.	36.	35.	34.	33.
32.	31.	30.	30.	29.	28.	27.	26.	26.	25.
24.	24.	23.	22.	22.	21.	21.	20.	19.	19.
18.	18.	17.	17.	16.	16.	16.	15.	15.	14.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	33.58	31.09	2.49	100620.

(853.11 790.11 63.11 2849.24)

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COMBINE HYDROGRAPHS

COMBINE INFLOW (SUBAREA A AND B)

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	2	0	0	0	0	1	0	0

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HYDROGRAPH ROUTING

MOD PULS ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QNTI1	QNTI2	QNTI3	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	1198.0	1220.0	5280.	.00380

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 1220.00 200.00 1210.00 896.00 1200.00 898.00 1198.00 902.00 1198.00
904.00 1200.00 1300.00 1210.00 1850.00 1220.00

STORAGE	0.00	.72	2.42	17.26	49.84	100.17	168.24	254.06	357.63
477478.94									
	618.00	773.68	941.42	1122.54	1316.96	1519.76	1730.75	1965.73	2207.29
2246.85									

OUTFLOW	0.00	9.62	37.47	227.78	832.86	2045.78	4031.01	6936.55	10899.17
/16047.18	22502.25	30757.32	40729.61	52240.34	65330.64	80046.01	96434.51	114545.80	134430.45
156139.56									
STAGE	1198.00	1199.16	1200.32	1201.47	1202.63	1203.79	1204.95	1206.11	1207.26
//1208.42	1209.58	1210.74	1211.89	1213.05	1214.21	1215.37	1216.53	1217.68	1218.84
//1220.00									
FLOW	0.00	9.62	37.47	227.78	832.86	2045.78	4031.01	6936.55	10899.17
116047.18	22502.25	30757.32	40729.61	52240.34	65330.64	80046.01	96434.51	114545.80	134430.45
156139.56									

MAXIMUM STAGE IS 1204.1

MAXIMUM STAGE IS 1204.1

MAXIMUM STAGE IS 1204.5

MAXIMUM STAGE IS 1204.6

MAXIMUM STAGE IS 1205.9

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SUB-AREA RUNOFF COMPUTATION

INFLOW SUBAREA C

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	4.56	0.00	4.56	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.00	112.00	122.00	136.00	146.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 7.08 CP= .55 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 4.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 7.15 HOURS, CP= .55 VOL= .79

1.	3.	7.	11.	15.	21.	26.	32.	39.	45.
52.	59.	67.	74.	82.	90.	98.	107.	115.	123.
132.	141.	150.	158.	166.	174.	181.	188.	195.	201.
206.	211.	216.	220.	224.	228.	230.	233.	235.	236.
237.	237.	236.	235.	233.	229.	224.	220.	215.	211.
207.	203.	199.	195.	191.	187.	183.	180.	176.	173.
169.	166.	162.	159.	156.	153.	150.	147.	144.	141.
138.	136.	133.	130.	128.	125.	123.	120.	118.	115.
113.	111.	109.	106.	104.	102.	100.	98.	96.	94.
92.	91.	89.	87.	85.	84.	82.	80.	79.	77.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM	33.58	31.09	2.49	254756.
	(853.1	790.1	63.1	7213.89)

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SUB-AREA RUNOFF COMPUTATION

INFLOW SUBAREA D

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	5.20	0.00	5.20	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.00	112.00	122.00	136.00	146.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 6.53 CP= .55 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES. LAG= 6.56 HOURS. CP= .55 VOL= .82

1.	4.	9.	15.	22.	29.	37.	45.	54.	64.
73.	83.	94.	104.	115.	126.	137.	149.	161.	172.
184.	196.	207.	217.	227.	236.	245.	252.	260.	266.
272.	277.	282.	286.	289.	291.	293.	294.	293.	292.
289.	284.	278.	272.	266.	260.	255.	249.	244.	239.
233.	228.	223.	219.	214.	209.	205.	200.	196.	192.
188.	184.	180.	176.	172.	168.	165.	161.	158.	154.
151.	148.	145.	141.	138.	135.	132.	130.	127.	124.
121.	119.	116.	114.	111.	109.	107.	104.	102.	100.
98.	96.	94.	91.	90.	88.	86.	84.	82.	80.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	33.58	31.09	2.49	31859B.
										(853.1(	790.1(	63.1(	9021.69)

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SUB-AREA RUNOFF COMPUTATION

INFLOW SUBAREA E

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.17	0.00	1.17	1.00	0.600	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96

0.00 25.00 112.00 122.00 136.00 146.00 0.00 0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 4.87 CP= .55 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 4.87 HOURS, CP= .55 VOL= .91

1.	2.	4.	7.	10.	13.	17.	21.	25.	29.
33.	38.	42.	47.	52.	56.	61.	65.	69.	73.
76.	79.	81.	84.	85.	87.	88.	88.	89.	88.
87.	85.	82.	80.	77.	75.	73.	71.	69.	67.
65.	63.	61.	59.	58.	56.	54.	53.	51.	50.
48.	47.	46.	44.	43.	42.	41.	39.	38.	37.
36.	35.	34.	33.	32.	31.	30.	29.	29.	28.
27.	26.	25.	25.	24.	23.	23.	22.	21.	21.
20.	20.	19.	18.	18.	17.	17.	16.	16.	15.
15.	15.	14.	14.	13.	13.	13.	12.	12.	12.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	33.58	31.09	2.49	92746.
										(853.1(	790.1(	63.1(	2626.2)

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SUB-AREA RUNOFF COMPUTATION

INFLOW SUBAREA F

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
8	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INFLOW	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.17	0.00	2.17	1.00	0.000	0	0	0

PRECIP DATA

SPFE	PXR	PX	PI2	PI24	PI48	PI72	PI96
0.00	23.00	112.00	122.00	136.00	146.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 5.28 CP= .55 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 5.27 HOURS, CP= .55 VOL= .89

1.	3.	7.	11.	15.	20.	26.	32.	38.	44.
51.	58.	65.	72.	79.	87.	94.	102.	109.	115.
121.	127.	131.	136.	140.	144.	146.	148.	150.	151.
151.	151.	149.	146.	143.	139.	135.	132.	128.	125.
121.	118.	115.	112.	109.	106.	103.	101.	98.	95.
93.	90.	88.	86.	83.	81.	79.	77.	75.	73.
71.	69.	67.	65.	64.	62.	60.	59.	57.	56.
54.	53.	51.	50.	49.	47.	46.	45.	44.	43.
41.	40.	39.	38.	37.	36.	35.	34.	33.	33.
32.	31.	30.	29.	28.	28.	27.	26.	26.	25.

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	33.58	31.09	2.49	161548.
										(853.1)	(790.1)	(63.1)	(4574.5)

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COMBINE HYDROGRAPHS

COMBINE INFLOW (SUBAREAS A,B,C,D,E AND F)

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
9	5	0	0	0	0	1	0	0

****

HYDROGRAPH ROUTING

ROUTE THRU EDINBORO LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
10	1	0	0	0	0	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	3.05	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.00	-1197.	-1

STAGE	1197.00	1198.00	1199.00	1200.00	1201.00	1202.00	1203.00	1206.00	1208.00
71210.00									

FLOW	0.00	270.00	780.00	1420.00	2190.00	2440.00	3120.00	3660.00	4140.00
154560.00									
SURFACE AREA=	0.	250.	588.	891.					
CAPACITY=	0.	2475.	3696.	11039.					
ELEVATION=	1167.	1197.	1200.	1210.					

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1197.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

D=25

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1204.5	2.9	1.5	110.

CREST LENGTH AT OR BELOW ELEVATION	30.	500.	950.	1400.
	1205.0	1210.0	1215.0	1220.0

PEAK OUTFLOW IS 3247. AT TIME 48.00 HOURS

PEAK OUTFLOW IS 3291. AT TIME 48.00 HOURS

PEAK OUTFLOW IS 4014. AT TIME 48.00 HOURS

PEAK OUTFLOW IS 5636. AT TIME 48.00 HOURS

PEAK OUTFLOW IS 16772. AT TIME 48.00 HOURS

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PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATION
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .39	RATIO 2 .49	RATIO 3 .59	RATIO 4 .60	RATIO 5 1.00
HYDROGRAPH AT	1	2.49	1	1671.	1713.	2141.	2569.	4282.
		(6.45)		(47.32)(	48.50)(	60.63)(	72.76)(	121.26)(
HYDROGRAPH AT	2	1.32	1	856.	878.	1098.	1317.	2195.
		(3.41)		(24.24)(	24.87)(	31.08)(	37.30)(	62.16)(
2 COMBINED	3	3.81	1	2525.	2590.	3238.	3885.	6475.
		9.87)		(71.51)(	73.34)(	91.68)(	110.02)(	183.36)(
ROUTED TO	4	3.81	1	2500.	2565.	3206.	3848.	6429.
		9.87)		(70.80)(	72.62)(	90.79)(	108.95)(	182.06)(
HYDROGRAPH AT	5	4.56	1	2288.	2346.	2933.	3519.	5866.
		(11.81)		(64.78)(	66.44)(	83.05)(	99.66)(	166.09)(
HYDROGRAPH AT	6	5.20	1	2790.	2861.	3577.	4292.	7154.
		(13.47)		(79.00)(	81.03)(	101.28)(	121.54)(	202.57)(
HYDROGRAPH AT	7	1.17	1	789.	810.	1012.	1214.	2024.
		3.03)		(22.35)(	22.93)(	28.66)(	34.39)(	57.32)(
HYDROGRAPH AT	8	2.17	1	1375.	1411.	1763.	2116.	3527.
		(5.62)		(38.95)(	39.95)(	49.94)(	59.92)(	99.87)(
5 COMBINED	9	16.91	1	9544.	9789.	12237.	14684.	24469.
		(43.80)		(270.27)(	277.20)(	346.50)(	415.80)(	692.90)(
ROUTED TO	10	16.91	1	3247.	3291.	4014.	5636.	16772.
		(43.80)		(91.95)(	93.20)(	113.66)(	159.58)(	474.92)(

PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS

.39	2500.	1204.1	44.67
.40	2565.	1204.1	44.67
.50	3206.	1204.5	44.67
.60	3848.	1204.8	44.67
1.00	6429.	1205.9	44.67

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1197.00	1197.00	1204.50
STORAGE	2475.	2475.	6627.
OUTFLOW	0.	0.	3255.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.39	1204.47	0.00	6606.	3247.	0.00	48.00	0.00
.40	1204.63	.13	6724.	3291.	.33	48.00	0.00
.50	1206.22	1.72	7903.	4014.	2.17	48.00	0.00
.60	1207.62	3.12	9009.	5636.	3.17	48.00	0.00
1.00	1211.21	6.71	12139.	16772.	5.00	48.00	0.00

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
  LAST MODIFICATION  01 APR 80
**********
    1          A1       RATIOS OF PMF ROUTED THROUGH THE RESERVOIY AND DOWNSTREAM
    2          A2       DOWNSTREAM CONDITIONS DUE TO DAM BREAK TEDINBORO LAKE DAM PA-181
    3          A3       PLANS 1 & 2 ASSUMES BREACH. PLAN 3 ASSUMES NO BREACH
    4          B   288       0      10       0       0       0       0       0      -4       0
    5          B1    5
    6          J     3       1       1
    7          J1   .5
    8          K     0       1                                               1
    9          K1       INFLOW SUBAREA A
   10          M     1       1    2.49                       1                               1
   11          P              23.     112     122     136     146
   12          T                                                       1.0    0.05
   13          W  4.91    0.55
   14          X -1.5    -.05     2.0
   15          K     0       2                                               1
   16          K1       INFLOW SUBAREA B
   17          M     1       1    1.32                       1                               1
   18          P              23.     112     122     136     146
   19          T                                                       1.0    0.05
   20          W  3.12    0.55
   21          X -1.5    -.05     2.0
   22          K     2       3                                               1
   23          K1       COMBINE INFLOW (SUBAREA A AND B)
   24          K     1       4                                               1
   25          K1       MOD PULS ROUTING
   26          Y                                       1       1
   27          Y1    1
   28          Y6  .06     .05     .06    1198    1220    5280   .0038
   29          Y7    0    1220     200    1210     896    1200     898    1198     902    1198
   30          Y7  904    1200    1300    1210    1850    1220
   31          K     0       5                                               1
   32          K1       INFLOW SUBAREA C
   33          M     1       1    4.56                       1                               1
   34          P              23.     112     122     136     146
   35          T                                                       1.0    0.05
   36          W  7.08    0.55
   37          X -1.5    -.05     2.0
   38          K     0       6                                               1
   39          K1       INFLOW SUBAREA D
   40          M     1       1    5.20                       1                               1
   41          P              23.     112     122     136     146
   42          T                                                       1.0    0.05
   43          W  6.53    0.55
   44          X -1.5    -.05     2.0
   45          K     0       7                                               1
```

```
46          K1      INFLOW SUBAREA E
47          M   1       1    1.17                        1                       1
48          P           23.     112     122     136     146
49          T                                                   1.0     0.05
50          W   4.87    0.55

51          X   -1.3    -.05    2.0
52          K    0       8                                      1
53          K1      INFLOW SUBAREA F
54          M   1       1    2.17                        1                       1
55          P           23.     112     122     136     146
56          T                                                   1.0     0.05
57          W   5.28    0.55
58          X   -1.3    -.05    2.0
59          K    9       9                                      1
60          K1      COMBINE INFLOW (SUBAREAS A,B,C,D,E AND F)
61          K    1      10                                     1
62          K1      ROUTE THRU EDINBORO LAKE
63          Y                                   1       1
64          Y1   1                                                  -1197   -1
65          Y4  1197    1198    1199    1200    1201    1202    1204    1206    1208    1210
66          Y5   0      270     780     1420    2190    2440    3120    3660    4140    4560
67          SA   0      250     588     891
68          SE1167.3    1197    1200    1210
69          SS  1197
70          SD1204.5    2.9     1.5     110
71          SL   30     500     950     1400
72          SV  1205    1210    1215    1220
73          SB   10     .5      1188    2       1197    1206
74          SB   83     0       1188    .17     1197    1206
75          SB   83     0       1188    .17     1197    1220
76          K    1      10                                     1
77          K1      STREAM ROUTING
78          Y                                   1       1
79          Y1   1
80          Y6  .06     .05     .06     1186    1200    1000    .001
81          Y7   0      1200    90      1190    100     1187    105     1186    135     1186
82          Y7  140     1190    150     1190    225     1200
83          K    99
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********

RUN  DATE= 81/01/26.
     TIME= 08.27.54.
```

RATIOS OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
DOWNSTREAM CONDITIONS DUE TO DAM BREAK (EDINBORO LAKE DAM PA-181)
PLANS 1 & 2 ASSUMES BREACH, PLAN 3 ASSUMES NO BREACH

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 3 NRTIO= 1 LRTIO= 1

RTIOS= .50

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SUB-AREA RUNOFF COMPUTATION

INFLOW SUBAREA A

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.49	0.00	2.49	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.00	112.00	122.00	136.00	146.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 4.91 CP= .55 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 4.89 HOURS, CP= .55 VOL= .91

1.	4.	9.	15.	21.	28.	36.	44.	52.	61.
70.	79.	89.	98.	108.	118.	128.	137.	145.	153.
160.	166.	171.	176.	180.	183.	185.	187.	187.	186.
184.	179.	174.	169.	164.	160.	155.	151.	146.	142.

138.	134.	130.	127.	123.	119.	116.	113.	110.	106.
103.	100.	98.	95.	92.	89.	87.	84.	82.	80.
77.	75.	73.	71.	69.	67.	65.	63.	61.	60.
58.	56.	55.	53.	52.	50.	49.	47.	46.	45.
43.	42.	41.	40.	39.	37.	36.	35.	34.	33.
32.	32.	31.	30.	29.	28.	27.	26.	26.	25.

0

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	33.58	31.09	2.49	196267.
										(853.)	(790.)	(63.)	(5557.66)

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SUB-AREA RUNOFF COMPUTATION

INFLOW SUBAREA B

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.32	0.00	1.32	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.00	112.00	122.00	136.00	146.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 5.12 CP= .55 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 5.13 HOURS, CP= .55 VOL= .90

1.	2.	4.	7.	10.	13.	17.	21.	25.	29.
33.	38.	42.	47.	52.	57.	62.	66.	71.	74.
78.	81.	84.	87.	89.	91.	93.	94.	95.	95.
95.	94.	92.	89.	87.	85.	82.	80.	78.	76.
74.	72.	70.	68.	66.	64.	62.	61.	59.	57.
56.	54.	53.	51.	50.	49.	47.	46.	45.	43.

42.	41.	40.	39.	38.	37.	36.	35.	34.	33.
32.	31.	30.	30.	29.	28.	27.	26.	26.	25.
24.	24.	23.	22.	22.	21.	21.	20.	19.	19.
18.	18.	17.	17.	16.	16.	16.	15.	15.	14.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	33.58	31.09	2.49	100620.

(883.1(790.1(63.1(2849.24)

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COMBINE HYDROGRAPHS

COMBINE INFLOW (SUBAREA A AND B)

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	2	0	0	0	0	1	0	0

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HYDROGRAPH ROUTING

MOD PULS ROUTING

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	1198.0	1220.0	5280.	.00380

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1220.00 200.00 1210.00 896.00 1200.00 898.00 1198.00 902.00 1198.00
904.00 1200.00 1300.00 1210.00 1850.00 1220.00

STORAGE	0.00	.72	2.42	17.26	49.84	100.17	168.24	254.06	357.63
478.94									
	618.00	773.68	941.92	1122.34	1314.96	1519.76	1736.75	1965.93	2207.29

2460.85									
OUTFLOW	0.00	9.62	37.47	227.78	832.86	2045.78	4031.01	6936.55	10899.17
16047.18									
	22502.25	30757.32	40729.61	52240.34	65330.64	80046.01	96434.51	114545.80	134430.45
156139.56									
STAGE	1198.00	1199.16	1200.32	1201.47	1202.63	1203.79	1204.95	1206.11	1207.26
1208.42									
	1209.58	1210.74	1211.89	1213.05	1214.21	1215.37	1216.53	1217.68	1218.84
1220.00									
FLOW	0.00	9.62	37.47	227.78	832.86	2045.78	4031.01	6936.55	10899.17
116047.18									
	22502.25	30757.32	40729.61	52240.34	65330.64	80046.01	96434.51	114545.80	134430.45
156139.56									

MAXIMUM STAGE IS 1204.5

MAXIMUM STAGE IS 1204.5

MAXIMUM STAGE IS 1204.5

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SUB-AREA RUNOFF COMPUTATION

INFLOW SUBAREA C

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	4.56	0.00	4.56	1.00	0.000	0	10	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.00	112.00	122.00	136.00	146.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 7.08 CP= .55 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 7.15 HOURS, CP= .55 VOL= .79

1.	3.	7.	11.	15.	21.	26.	32.	39.	45.
52.	59.	67.	74.	82.	90.	98.	107.	115.	123.
132.	141.	150.	158.	166.	174.	181.	188.	195.	201.
206.	211.	216.	220.	224.	228.	230.	233.	235.	236.
237.	237.	236.	235.	233.	229.	224.	220.	215.	211.
207.	203.	199.	195.	191.	187.	183.	180.	176.	173.
169.	166.	162.	159.	156.	153.	150.	147.	144.	141.
138.	136.	133.	130.	128.	125.	123.	120.	118.	115.
113.	111.	109.	106.	104.	102.	100.	98.	96.	94.
92.	91.	89.	87.	85.	84.	82.	80.	79.	77.

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

SUM	33.58	31.09	2.49	254756.
	(853.)(	790.)(	63.)(	7213.89)

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SUB-AREA RUNOFF COMPUTATION

INFLOW SUBAREA D

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUMG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	5.20	0.00	5.20	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.00	112.00	122.00	136.00	146.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 6.53 CP= .55 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 6.56 HOURS, CP= .55 VOL= .82

1.	4.	9.	15.	22.	29.	37.	45.	54.	64.
73.	83.	94.	104.	115.	126.	137.	149.	161.	172.
184.	196.	207.	217.	227.	236.	245.	252.	260.	266.
272.	277.	282.	286.	289.	291.	293.	293.	293.	292.
289.	284.	278.	272.	266.	260.	255.	249.	244.	239.
233.	228.	223.	219.	214.	209.	205.	200.	196.	192.
188.	184.	180.	176.	172.	168.	165.	161.	158.	154.
151.	148.	145.	141.	138.	135.	132.	130.	127.	124.
121.	119.	116.	114.	111.	109.	107.	104.	102.	100.
98.	96.	94.	91.	90.	88.	86.	84.	82.	80.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	33.58	31.09	2.49	318598.
										1 853.11	790.11	63.11	9021.691

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SUB-AREA RUNOFF COMPUTATION

INFLOW SUBAREA E

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO

7	0	0	0	0	0	1	0	0	

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.17	0.00	1.17	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.00	112.00	122.00	136.00	146.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 4.87 CP= .55 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 4.87 HOURS, CP= .55 VOL= .91

1.	2.	4.	7.	10.	13.	17.	21.	25.	29.
33.	38.	42.	47.	52.	56.	61.	65.	69.	73.
76.	79.	81.	84.	85.	87.	88.	88.	89.	88.
87.	85.	82.	80.	77.	75.	73.	71.	69.	67.
65.	63.	61.	59.	58.	56.	54.	53.	51.	50.
48.	47.	46.	44.	43.	42.	41.	39.	38.	37.
36.	35.	34.	33.	32.	31.	30.	29.	29.	28.
27.	26.	25.	25.	24.	23.	23.	22.	21.	21.
20.	20.	19.	18.	18.	17.	17.	16.	16.	15.
15.	15.	14.	14.	13.	13.	13.	12.	12.	12.

END-OF-PERIOD FLOW

0 MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	33.58	31.09	2.49	92746.
										(853.11	790.11	63.11	2626.27)

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SUB-AREA RUNOFF COMPUTATION

INFLOW SUBAREA F

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
8	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	2.17	0.00	2.17	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	23.00	112.00	122.00	136.00	146.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP

0 0.00 0.00 1.00 0.00 0.00 1.00 1.00 .05 0.00 0.00

UNIT HYDROGRAPH DATA
TP= 5.20 CP= .55 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 100 END-OF-PERIOD ORDINATES, LAG= 5.27 HOURS, CP= .59 VOL= .89
1. 3. 7. 11. 15. 20. 26. 32. 38. 44.

51.	58.	65.	72.	79.	87.	94.	102.	109.	115.
121.	127.	131.	136.	140.	143.	146.	148.	150.	151.
151.	151.	149.	146.	143.	139.	135.	132.	128.	125.
121.	118.	115.	112.	109.	106.	103.	101.	98.	95.
93.	90.	88.	86.	83.	81.	79.	77.	75.	73.
71.	69.	67.	65.	64.	62.	60.	59.	57.	56.
54.	53.	51.	50.	49.	47.	46.	45.	44.	43.
41.	40.	39.	38.	37.	36.	35.	34.	33.	33.
32.	31.	30.	29.	28.	28.	27.	26.	26.	25.

END-OF-PERIOD FLOW

O MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	33.58	31.09	2.49	161548.
										(853.1(	790.1(	63.1(	4574.53(

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COMBINE HYDROGRAPHS

COMBINE INFLOW (SUBAREAS A,B,C,D,E AND F)

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
9	8	0	0	.0	0	1	0	0

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HYDROGRAPH ROUTING

ROUTE THRU EDINBORO LAKE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
10	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1197.	-1

STAGE	1197.00	1198.00	1199.00	1200.00	1201.00	1202.00	1204.00	1206.00	1208.00	1210.00

FLOW	0.00	270.00	780.00	1420.00	2190.00	2440.00	3120.00	3660.00	4140.00
154560.00									
SURFACE AREA=	0.	250.	588.	891.					
CAPACITY=	0.	2475.	3696.	11039.					
ELEVATION=	1167.	1197.	1200.	1210.					

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
1197.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

1	0	0	0.000	0.000	0.000	0.	0

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	1186.0	1200.0	1000.	.00100

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1200.00 90.00 1190.00 100.00 1187.00 105.00 1186.00 135.00 1186.00
140.00 1190.00 150.00 1190.00 225.00 1200.00

STORAGE	0.00	.55	1.17	1.84	2.58	3.37	4.34	5.58	7.02
1218.67	10.52	12.58	14.84	17.31	19.98	22.87	25.95	29.24	32.74
1236.44									
OUTFLOW	0.00	17.37	58.06	118.55	196.87	292.49	409.30	556.74	735.44
154947.74	1196.16	1483.21	1811.30	2182.79	2599.96	3065.05	3580.24	4147.64	4769.34
155447.39									
STAGE	1186.00	1186.74	1187.47	1188.21	1188.95	1189.68	1190.42	1191.16	1191.89
1192.63	1193.37	1194.11	1194.84	1195.58	1196.32	1197.05	1197.79	1198.53	1199.26
1200.00									
FLOW	0.00	17.37	58.06	118.55	196.87	292.49	409.30	556.74	735.44
155947.74	1196.16	1483.21	1811.30	2182.79	2599.96	3065.05	3580.24	4147.64	4769.34
155447.39									

MAXIMUM STAGE IS 1198.3

MAXIMUM STAGE IS 1209.6

MAXIMUM STAGE IS 1198.3

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO APPLIED TO FLOWS 1 .50
HYDROGRAPH AT	1	2.49	1	2141.
		(6.45)		(60.63)(
			2	2141.
				(60.63)(
			3	2141.
				(60.63)(
HYDROGRAPH AT	2	1.32	1	1098.
		(3.42)		(31.08)(
			2	1098.
				(31.08)(
			3	1098.
				(31.08)(
2 COMBINED	3	3.81	1	3238.
		(9.87)		(91.68)(
			2	3238.
				(91.68)(
			3	3238.
				(91.68)(
ROUTED TO	4	3.81	1	3206.
		(9.87)		(90.79)(
			2	3206.
				(90.79)(
			3	3206.
				(90.79)(
HYDROGRAPH AT	5	4.56	1	2933.
		(11.81)		(83.05)(
			2	2933.
				(83.05)(
			3	2933.
				(83.05)(
HYDROGRAPH AT	6	5.20	1	3577.
		(13.47)		(101.28)(

			2	3577.
			(	101.28)(
			3	3577.
			(	101.28)(
HYDROGRAPH AT	7	1.17	1	1012.
	(	3.03)	(	28.66)(
			2	1012.
			(	28.66)(
			3	1012.

AD-A097 237 KIMBALL (L ROBERT) AND ASSOCIATES EBENSBURG PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. OHIO RIVER BASIN, CONNEAUTEE C--ETC(U)
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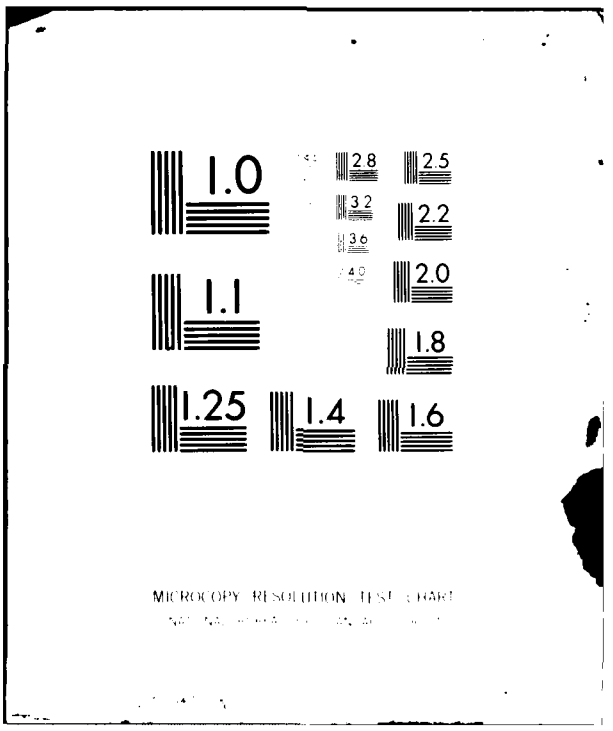
1.0
2.8
2.5
3.2
2.2
3.6
4.0
2.0
1.1
1.8
1.25
1.4
1.6
MICROCOPY RESOLUTION TEST CHART

			1	28.66
HYDROGRAPH AT	8	2.17	1	1763.
		5.62		49.93
			2	1763.
				49.93
			3	1763.
				49.93
5 COMBINED	9	16.91	1	12237.
		43.80		346.50
			2	12237.
				346.50
			3	12237.
				346.50
ROUTED TO	10	16.91	1	4037.
		43.80		114.32
			2	22830.
				637.97
			3	4014.
				113.66
ROUTED TO	10	16.91	1	3993.
		43.88		113.07
			2	14294.
				404.77
			3	3981.
				112.72

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PLAN 1 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3206.	1204.5	44.67

PLAN 2 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3206.	1204.5	44.67

PLAN 3 STATION 4

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3206.	1204.5	44.67

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1197.00	1197.00	1204.50
STORAGE	2475.	2475.	6627.
OUTFLOW	0.	0.	3259.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1206.22	1.72	7903.	4037.	2.17	48.00	47.83

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1197.00	1197.00	1204.50
STORAGE	2475.	2475.	6627.
OUTFLOW	0.	0.	3259.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1206.16	1.66	7856.	22530.	2.17	48.00	47.83

PLAN 3 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1197.00	1197.00	1204.50
STORAGE	2475.	2475.	6627.
OUTFLOW	0.	0.	3259.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1206.22	1.72	7903.	4014.	2.17	48.00	0.00

PLAN 1 STATION 10

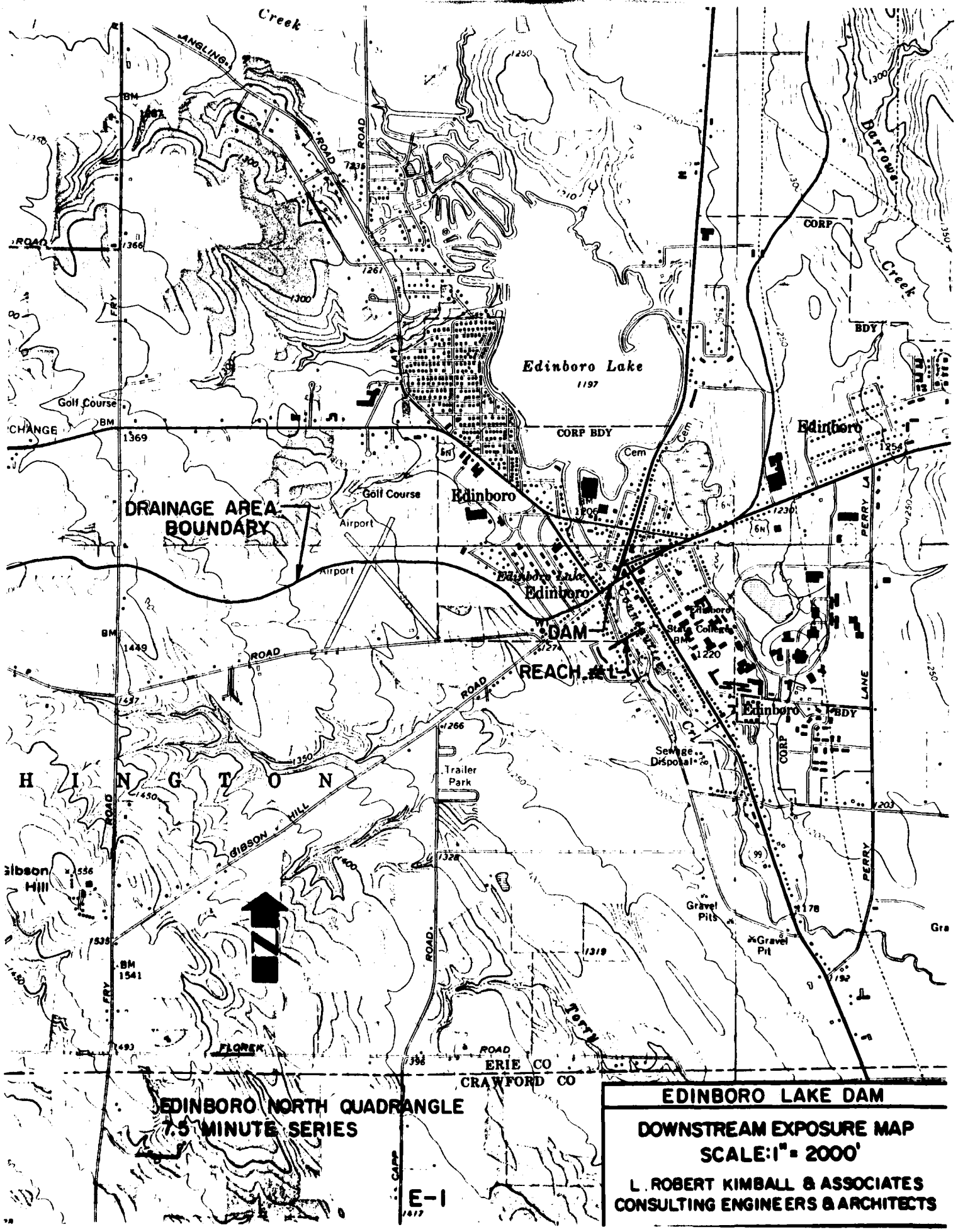
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	3993.	1198.3	48.00

PLAN 2 STATION 10

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	14294.	1209.6	48.00

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.55	5981.	1198.5	48.00

APPENDIX E
DRAWINGS



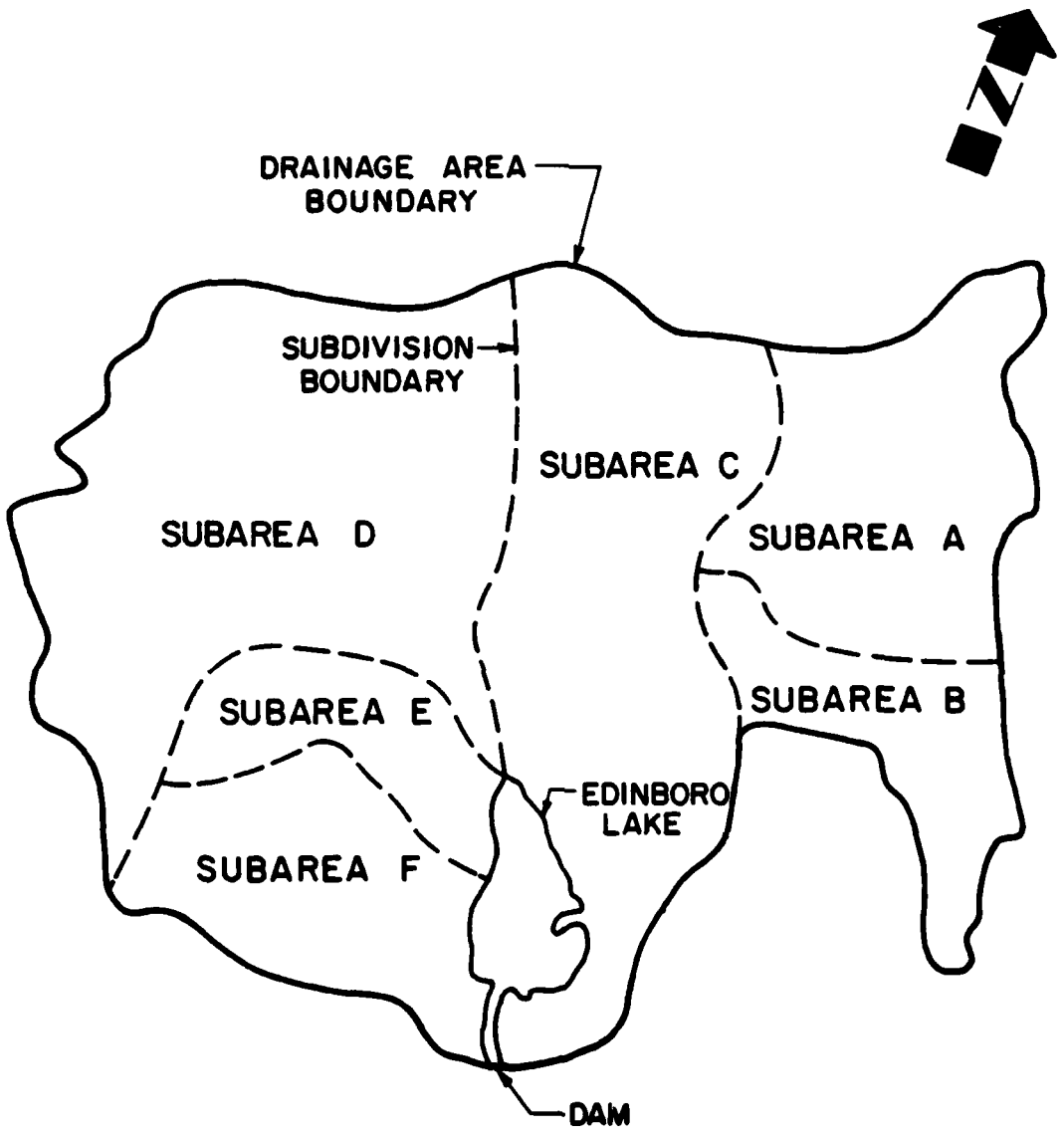
EDINBORO NORTH QUADRANGLE
7.5 MINUTE SERIES

E-1

EDINBORO LAKE DAM

DOWNSTREAM EXPOSURE MAP
SCALE: 1" = 2000'

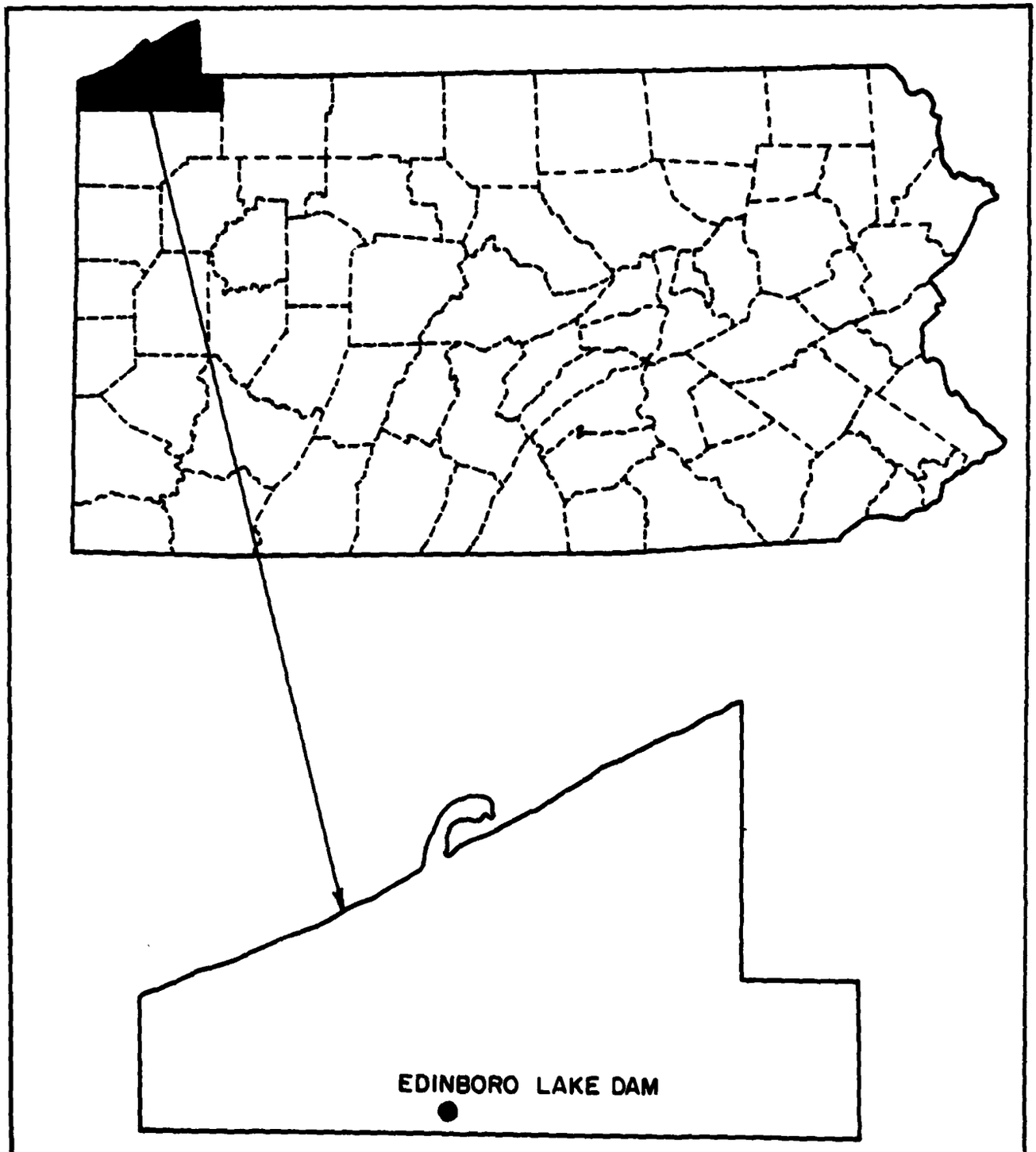
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS



EDINBORO LAKE DAM

DRAINAGE AREA MAP

SCALE: 1" = 5000'

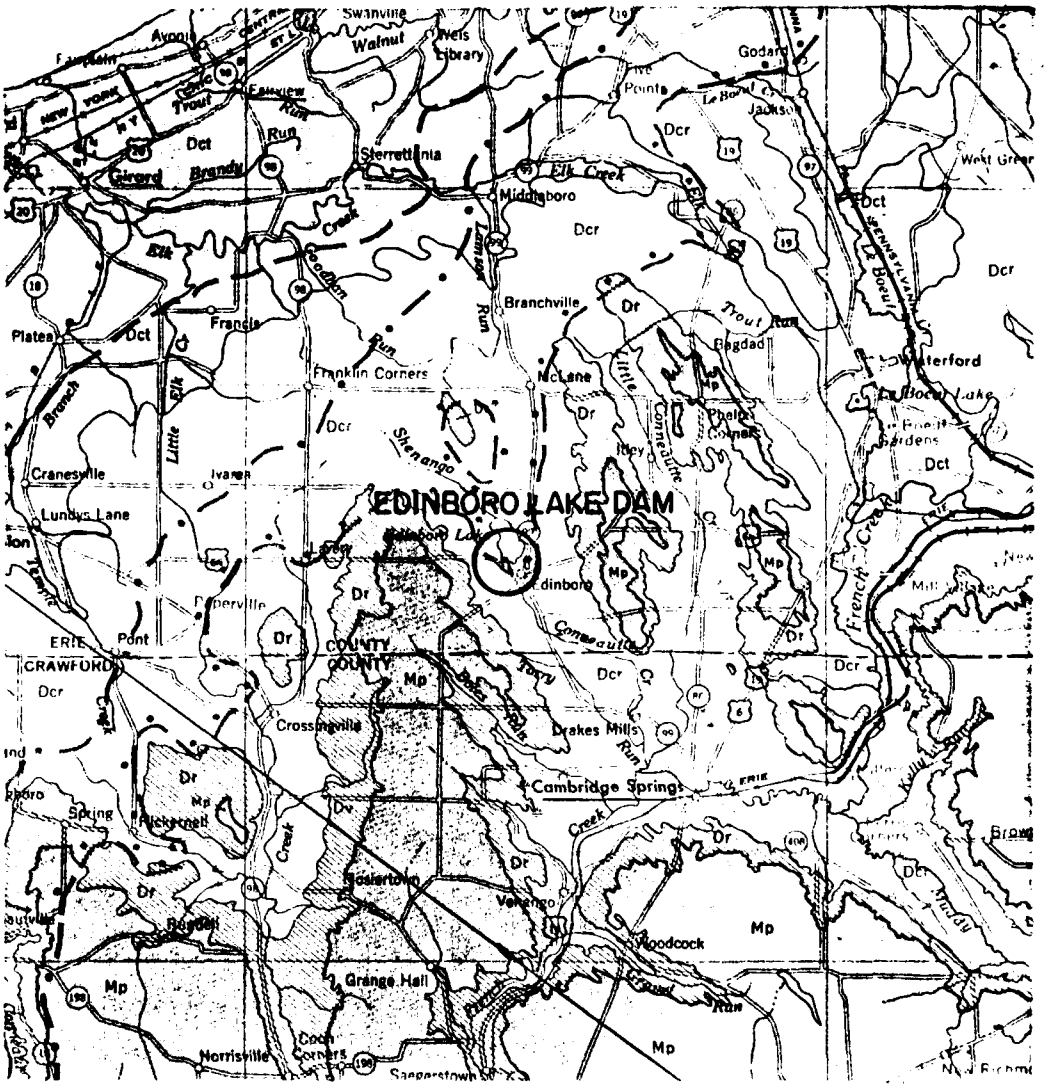


SITE LOCATION MAP
ERIE COUNTY, PENNSYLVANIA

APPENDIX F
GEOLOGY

General Geology

The Edinboro Lake Dam is located in the Glaciated Section of the Appalachian Plateaus Province. This section is an area where the advancing and retreating ice sheets of pleistocene time deposited drift over the bedrock and filled the valleys with glacial outwash. This drift and glacial outwash is generally composed of clay, sand, and gravel, though in some places the drift is a dense impervious till. The sand and gravel of the glacial drift are by far the largest producers of groundwater in this area. The bedrock underlying the dam consists of gray and brown shale and sandstone, with some limestone, belonging to the Catteraugus Formation of Upper Devonian Age. The rocks generally appear to be horizontal, though there is a slight regional dip to the south of less than one degree. Irregularities in the dip do exist, but are usually slight. No faulting is indicated in the vicinity of the Edinboro Lake Dam.



GEOLOGIC MAP OF AREA AROUND EDINBORO LAKE DAM

SCALE 1:250,000

QUATERNARY

PLEISTOCENE

NORTHWESTERN PENNSYLVANIA

- Border of Ashtabula drift
- Border of Hiram drift
- Border of Lavery drift
- Border of Kent drift

Cary Substage — Wisconsin Stage

EASTERN PENNSYLVANIA

- Border of Wisconsin drift

Qcm — **Cape May Formation**
Sands and gravels with clay and silt at the base locally overlain by areas of Recent alluvium and swamp deposits

DEVONIAN

WESTERN PENNSYLVANIA

Dost Dr — **Oswayo Formation**

Dcr — **Catskill Formation**

Dct — **Conneaut Group**
Alternating gray, brown, greenish and purplish shales and siltstones, includes "pink rock" of drillers and "Chemung and "Girard" Formations of northwestern Pennsylvania

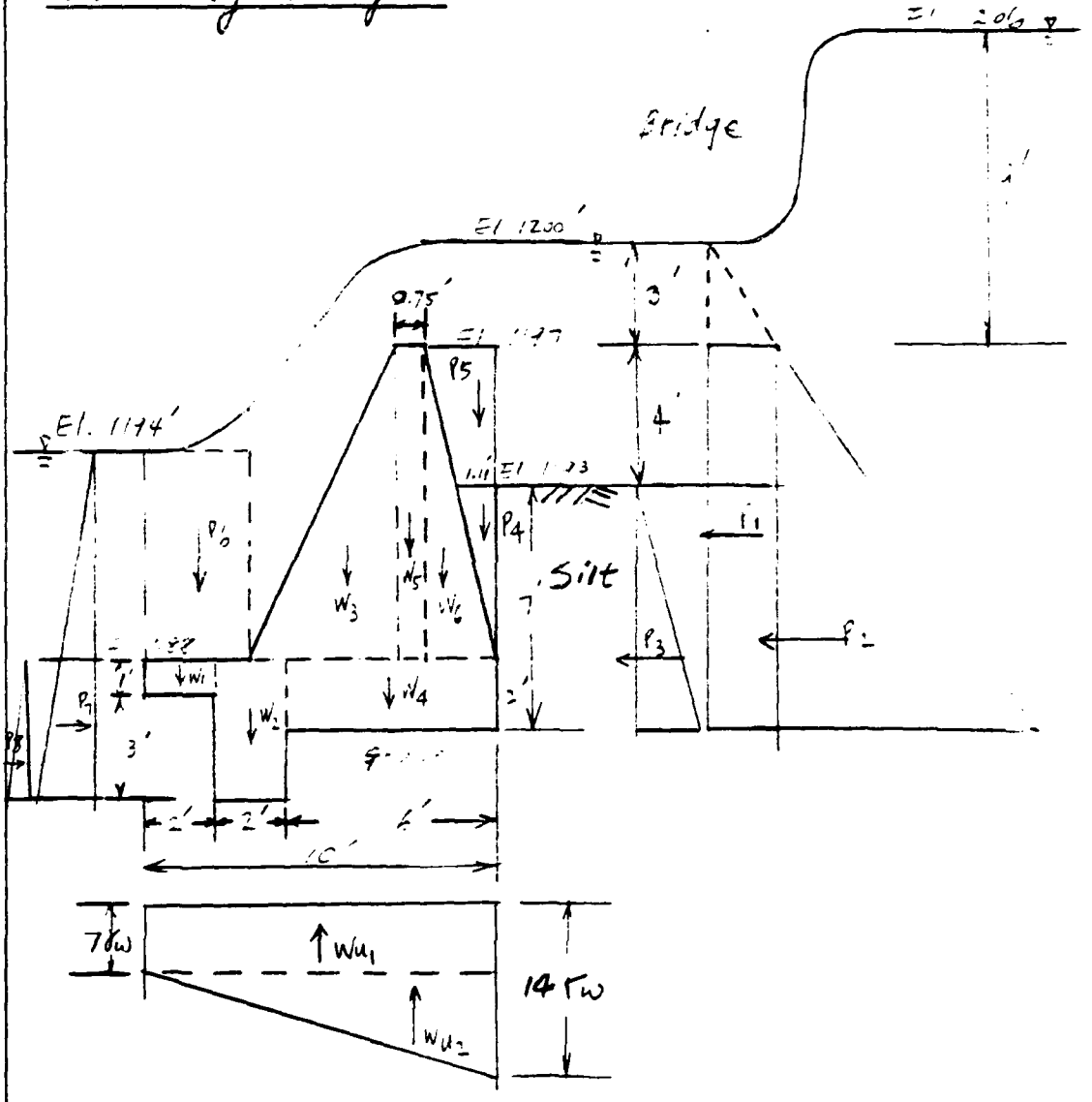
Dca — **Canadaway Formation**
Alternating brown shales and sandstones to include "Perrysburg" Formation of northwestern Pennsylvania

APPENDIX G
STABILITY ANALYSIS

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

NAME
NUMBER
SHEET NO. 1 OF 5
BY DATE

Stability Analysis



Assumptions: 1. Velocity head is negligible

length of spillway = 83'

$A = (83)(7) = 581$ sq ft

From HEC 1 result, Q = 4000 cfs $\therefore$ $y = \frac{4000}{581} = 6.88$ ft

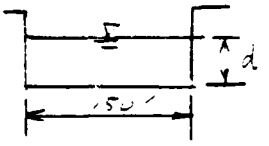
$h_v = \frac{v^2}{2g} = 0.7$ ft ∴ neglected

2. Assume tailwater elevation is at El. 1191'

From Manning's Formula

$$Q = \frac{1.49}{n} A R^{2/3} S^{1/2}, \quad Q = \text{flow cfs}, \ S = 0.001 \text{ (From HEC 1)}$$

Assuming downstream channel is rectangular-shaped



$n = 0.035$

$$Q = \frac{1.49}{0.035}(150d)\left[\frac{150d}{150+2d}\right]^{2/3}(0.001)^{1/2} \quad \therefore d = 6'$$

$$\text{Elevation}_{\text{tailwater}} = 1188 + 6 = 1194'$$

3. F_s for silt and gravel = 2.65

4 ϕ for silt and gravel = 30°

5 dry unit weight of silt & gravel = 100 pcf

6 Unit weight of rubble concrete = 145 pcf

7 Coeff. of friction between concrete and gravel = 0.75

1. Uplift pressure is linearly distributed.

Water Pressure

$P_1 = (3)(62.4)(11) = 2059.2$ #

$P_2 = \frac{(11)^2}{2}(62.4) = 3775.2$ #

$P_5 = (2)(9)(\frac{1}{2})(62.4) = 561.60$ #

$P_6 = (3)(6)(62.4) = 1123.2$ #

$P_7 = (10)^2(\frac{1}{2})(62.4) = 3120$ #

Effective Earth Pressure

Submerged Unit weight of soil = γ_{sat}

$= 100\left(\frac{2.65-1}{2.65}\right) = 62.26$ pcf

$P_3 = \frac{(62.26)(7)^2}{2}\left(\frac{1-\sin 30}{1+\sin 30}\right) = 508.46$ #

$P_4 = (1.11)(5)(\frac{1}{2})(62.26) = 172.$ #

$P_8 = \frac{(4)^2}{2}(62.26)\left(\frac{1+\sin 30}{1-\sin 30}\right) = 1494.2$ #

Weight of the Dam

$W_1 = (2)(1)(145) = 290$ lb

$W_2 = (4)(2)(145) = 1160$ lb

$W_3 = \frac{1}{2}(4.25)(9)(145) = 2773.13$ lb

$W_4 = (2)(6)(145) = 1740.0$ lb

$W_5 = (0.75)(9)(145) = 978.75$ lb

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

NAME
NUMBER
SHEET NO. 4 OF 5
BY IS DATE

$W_6 = (2)(9)(\frac{1}{2})(145) = 1305$ #

Total wt: 9246.88 #

Uplift Water Pressure

$W_{u_1} = (7)(62.4)(10) = 4368$ #

$W_{u_2} = (\frac{1}{2})(7)(62.4)(10) = 2184$ #

Total = 6552 #

Stability against Sliding

$$F.S_{\text{sliding}} = \frac{(9246.88 - 6552 + 172.77 + 561.60 + 1123.20 + 3120 + 1624.26}{2059.2 + 3775.2 + 508.46}$$

$$= \frac{6390.47}{6342.86} = 1.01 < 1.5$$

Stability against overturning (Neglect F_2)

Resisting Moment $= (290)(1) + (1160)(3) + (2773.13)\left(3 + \frac{2(4.25)}{3}\right)$
$+ (1740)(7) + (978.75)\left(7.25 + \frac{0.75}{2}\right) + (1305)\left(18 + \frac{2}{3}\right)$
$+ (172.77)\left(10 - \frac{1.11}{3}\right) + (561.60)\left(10 - \frac{2}{3}\right) + (1123.2)(11.5)$
$+ (3120)\left(7 - \frac{2.0}{3}\right)$

$= 290 + 3480 + 16176.59 + 12180. + 7462.97 + 12910.80$
$+ 1663.78 + 5241.41 + 1684.8 + 10400$

$= 60529.99$ ft-lb

Driving Moment
$= (2059.2)(5.5 - 1) + (3775.2)\left(\frac{11}{3} - 1\right) + (508.46)\left(\frac{7}{3} - 1\right) + (1368)$
$(18) + 2184\left(\frac{2.0}{3}\right)$ $= 9266.4 + 10067.2 + 577.95 + 21840 + 14560$

$= 56411.55$ ft-lb

$F.S_{overturning} = 1.07 < 1.5$

$\Sigma V = 8246. + 1727 + 561.60 + 1123.2 - 6552 = 3551.57$ lb

$\Sigma M = 60529.99 - 56411.55 = 4118.44$ ft-lb

$\Sigma M / \Sigma V = 1.16$ ft

$\frac{1}{3}(11) = 3.67' > 1.16'$ ∴ resultant falls outside of the middle third of the base.


DATE
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-8